RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.

PUBLISHED EVERY FRIDAY BY THE RAILROAD GAZETTE AT 83 FULTON STREET, NEW YORK
BRANCH OFFICES AT 375 OLD COLONY BUILDING, CHICAGO, AND QUEEN ANNE'S CHAMBERS, WESTMINSTER, LONDON

EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It contains selected reading pages from the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

OFFICERS.—In accordance with the law of the state of New York, the following announcement is made of the office of publication, at 83 Fulton St., New York, N.Y., and the names of the officers and editors of The Railroad Gazette:

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VOL. XLIV., No. 12. FRIDAY, MARCH 20, 1908.

Bion J. Arnold, who was some time ago engaged by the Public Service Commission for New York City to report improvements which might be made to the present Interborough Rapid Transit subway, has made a further report to the Commission dealing with improvements which can be made to the express stations and to the signal system of the subway. Mr. Arnold's report on the Subway Car was published in the *Railroad Gazette* of February 28 and March 6, 1908. Mr. Arnold declares that the existing signal system, when it was put in in 1904, was as complete as it was possible to make it, but that the art of signaling has made rapid strides since that time. Besides advocating a change in the signal system on the express tracks, which will provide an automatic stop for trains entering stations and the extension of the signal system used on the express tracks to the local tracks, Mr. Arnold's most novel recommendation is that the express stations should be double decked, so as to make it possible for two express trains to lie in a station at the same time, alternating on one and the other side of the express platform, the local trains running underneath the express level. This he believes would increase the capacity of the subway by fully 50 per cent., because the great delays in the subway come in unloading and loading passengers. There is said to be room for double decking the express stations without additional excavation, with a possible exception at Ninety-sixth street. At present during the rush hours each express train usually has to wait just short of each express station while the train in advance is discharging and taking passengers at that station platform. With capacity for receiving two express trains at the same time at each platform, a second train could pull into the platform and begin unloading while the first train was finishing its loading and about to pull out. Mr. Arnold's recommendations in regard to the signal system are summed up in another column.

We print this week in pretty full detail a very noteworthy document: the report of the commissioners appointed to investigate the Quebec bridge failure. The finding that the professional knowledge of the present day concerning the action of steel columns under load is not sufficient to enable engineers to design economically such structures as the Quebec bridge is immensely important, but it tells only part of the story, for the commissioners specifically deny that there was any improper desire of economy or any neglect of duty. The bridge fell because its design was fundamentally wrong, insufficient provision having been made for unit stresses higher than any established by past practice. The dead load upon which the calculations were based was assumed at too low a value, and the error got past all the engineers who should have detected it. But this error, great as it was, might have been detected early or might at least have been prevented from working terrible harm had it not been for the fact that "the greatest bridge in the world was being built without there being a single man within reach who by experience, knowledge and ability was competent to deal with the crisis." The bridge company had the services of an excellent consulting bridge engineer, but, owing to Mr. Cooper's advancing years and ill health, they were absentee services. The correspondence quoted from the report shows perfectly clearly the instant apprehension of the consulting engineer at the first sign of danger; but he was ill, he was a long distance from the work, and there was nobody on the ground possessing either the experience to grasp the full meaning of the desperate situation which had arisen or the combined experience and authority needed to deal with it. The commissioners say, "the impression left with us is that throughout the work Mr. Cooper was in a position of a man forced in the interests of the work to take responsibility which did not fully belong to his position and which he was not authorized to take, and that he avoided the assumption of authority whenever possible." So here we have the two great causes of the disaster: defective design, and a defective organization for doing the work. No further comment need be made. The rewards which compensate the engineer who has succeeded are not great, apart from the joy and pride of conquering quietly and progressively all the difficulties, old and new, which nature provides with such abundance, and of realizing that there are a few who know and appreciate; the penalties and the sorrow of failure are perhaps greater than in any other profession.

The announcement by the Georgia Railway Commission that Mr. Harriman and his associates bought the Central Railroad of Georgia last summer through their agents, Oakleigh Thorne and Marsden J. Perry, is of unusual interest, for several reasons. First of all, because a transcontinental system has been created within the boundaries of the United States under common control. Details of Mr. Harriman's exact holdings in the Georgia Central are lacking, just as they are in the case of the Illinois Central, but it is clear that the Harriman party commands the policy and resources of both these roads, which together afford a through route from Omaha, Neb., to

Savannah, Ga., by way of the new Illinois Central extension to Birmingham, Ala., described on nother page last week. The Gould interests have been measurably close to a transcontinental line for some years, and when the Western Pacific is completed the only gap between Oakland and the terminus of the Western Maryland at Baltimore will be a stretch of 100 miles or so (of exceedingly difficult country) in the West Virginia mountains between the West Virginia, Central & Pittsburgh and the Wheeling & Lake Erie. But Mr. Harriman has a good deal better through route than this could have been. The grades on the Denver & Rio Grande and on the West Virginia, Central & Pittsburgh are not adapted to a heavy through haul, and the difficulties in connection with the West Virginia mountain strip of intervening territory are so great that no active attempt to close the gap is being made. On the other hand, the Harriman route from the Pacific coast right through to Birmingham, Ala., is thoroughly well adapted for heavy traffic, and the Georgia mileage, although not yet developed for that purpose, ought to be capable of development at comparatively small expense. To what actual use this combination of roads will be put in its capacity as a transcontinental line, is another question. The Illinois Central has a most excellent, substantial, capacious line from Chicago to New Orleans, with easy grades favoring southbound traffic. The Southern Pacific has a line of freight and passenger steamers from Galveston and New Orleans to New York which can handle through business with the greatest advantage and economy, and it is not clear that it would benefit the system to haul transcontinental traffic over the Central of Georgia to Savannah, thereby competing with the Illinois Central gulf lines and with the great fleet of Southern Pacific coastwise steamers. The Central of Georgia also has an excellent fleet running between Savannah and New York. This steamship property has been carried upon the Georgia Central balance sheet at an absurdly small figure, in view of the fact that all the steamers now in commission are large, new boats, none of them except the "Kansas City" being more than six years old and all being excellently adapted to the traffic, and the inference is a fair one that this service has been so profitable that much of the actual cost of this fleet has been met out of surplus earnings. It is not clear how the Harriman system will derive any advantage from using this Savannah fleet to compete with the New Orleans fleet for through traffic. It seems more likely that the best use of the Georgia Central will be as a large and very important local railroad, fully able to take care of itself, with its sphere of usefulness extended by the additional traffic which the western connections will be able to give it. But, after all, the greatest value of this property to the Harriman system probably lies in the fact that it is thereby kept out of the hands of the Rock Island.

RIFTS IN THE RAILROAD CLOUDLAND.

The president of a great railroad system, itself not so severely visited by adverse legislation as some other systems, recently in a semi-private talk expressed his fears that the present general onset upon the railroads presaged ultimately one of two things—compulsory and arbitrary scaling down of their values by state action or a smaller scaling down under federal ownership. Such words were the language of pessimism albeit they represent in these strange times what too many people who are always looking toward the sunset rather than to the dawn, are saying or thinking. It is one of the evils of hard times that their ills are not merely concrete. They also tend to create a kind of atmosphere which, breathed in, infects overmuch the vision and distorts the perspective. In such atmospheric conditions it is well now and then to take a draught of ozone and readjust vision to its true focus. Nor, somber as the general outlook may be, is such a search for rifts in the railroad cloudland in vain, nor like an attempt to draw rays from the cucumber, nor to demonstrate the much-disputed canals of Mars. The bright rifts in the railroad situation are really there and likely to widen rather than narrow—especially after election.

Let us take, for one example, that valuation idea which rises every few days like an uneasy ghost, and has but lately assumed somewhat clearer apparent outlines, while not more tangible really, in the Nebraska platform, which is known to be Mr. Bryan's own, and which may be rebuilt at Denver along the same lines. It scares somewhat conservative railroad investors already made nervous by previous events. But how many of them remember in that connection the "due process" clause of the federal constitution relating to property and how it stands right athwart anything that savors of confiscation? "Valuation" of railroad properties means a process of such intricacy, such an excursion into an infinity of varying values, such an unraveling of tangled and obscured skeins of interests complicated by time and change as would defy the labors of the economic gods. But even were it practical, how much have the railroads actually to fear? Not a few of them, if extinction of old investment by reorganization is reckoned in, are under-capitalized rather than over-capitalized by a fair valuation test. Others have been solidified by the immense increase of their realty values, especially when they include terminals in great cities. Under constitutional limitations and checks the very worst that valuation could do, in the case of the steam roads, would be the clipping of the edges of speculative securities. Even in the case of speculative issues, which morally deserve small pity, most of them are protected behind state law, though that does not prevent them, perhaps, from being reached by legislative reduction of rates. This would apply, however, to street railways rather than to the steam roads, honest investors in which can afford to treat valuation as a bogy and rely pretty confidentially on the courts to resist confiscation by statutory rate-making.

Another rift in the clouds is descried, when one studies the present phase of railroad contraction. We have now begun to reach the after-panic period when the procession of receiverships has started. But no great railroad system has yet joined it. What is of more importance, unlike the after-panic periods of the seventies and early nineties, the recent receiverships have come, usually, not as the sequel of basic railroad weakness, but of credit contraction. There has, of course, been contraction of earnings, but this has been a minor factor; there has been a malign influence reaching somewhat further in the form of state and federal action; but the main cause has been stagnated credit at a time when only the highest security commands funds. Though the distinction may seem a fine one, the recent receiverships in railroads have been fiscal rather than physical, as they were after 1873 and 1893. Then they were the result of an undue mass of debt in ratio to physical capacity and earning power; now they come when physical capacity is good and indeed so good that it has been seeking extension, but has been met by sudden and unlooked for collapse of borrowing power. The distinction seems obvious, as also its corollary that the railroad receiverships of 1908, unless hard times greatly deepen and lengthen, will perhaps not involve any great railroad system, and will many of them be transitory without root and branch reorganizations—in this respect not unlike the suspension of certain New York banking institutions.

In this connection another rift to be watched for hopefully is the market for railroad bonds, the real financial criterion of railroad credit. Through that fissure in the gloom there gleamed a cheering light in January. The normal reaction from panic conditions seemed then to have set in. Capital, made timid by panic, had begun to seek actively senior classes of good railroad bonds for investment, and the demand had even begun to reach the junior bonds of the stronger roads, and promised to extend downward still further and alleviate the strain on railroad credit. Why the upward movement of railroad credit ceased within three weeks is partly conjectural. Those who attribute it to the exhaustion of dividend investments may possibly be as near to the truth as those who charge it to the untimely utterances of the President. But, whatever the cause, the normal drift of capital into railroad bonds has probably suffered a pause, not a check. That the free capital exists to renew it is at least suggested by the great over-subscription to the New York City loan and the success and high premium of the new $39,000,000 loan of the New York, New Haven & Hartford. Upon the future of railroad bonds during 1908 the solution of the railroad situation very largely depends and, on the whole, the outlook is not unpromising save for "politics" and unnatural interference by high officialdom with the national law of post-panic recovery.

We have referred to certain breaks in the railroad obscurity which are secondary in character and remote from others which are primary and more visible, such as the underlying strength of the nation's industries, the powers of common law as a check on demagogism, the final triumph of common sense and of the axioms of political economy and the bracing fact that a presidential campaign cannot last forever. But while optimism still has the vantage of pessimism the deeper must be the regret that the rifts in the railroad cloudland are not broader, that they do not open faster and that in the commercial quarter the horizon still remains so thick. The curt phrase, "net earnings" of the railroads are the final test words, and those in time rest on general trade conditions. How far and how long they, in their turn, are to be distempered by policies external, hasty and rash, only time will inform us. If

they could only be let alone prophecy would be both more definite and more reassuring.

THE ENGINEERING DIFFICULTIES OF THE HUDSON & MANHATTAN TUNNEL.

The shield method has now been used so often for subaqueous tunneling that from the engineering standpoint there is nothing new or particularly interesting about its general principles. The striking features of such work are the means devised to meet unique difficulties. It is here that the duties of the engineer in overcoming natural forces branch out into the romance of achievement. The twin Hudson & Manhattan tunnels recently opened for traffic under the Hudson river between New York and Hoboken, had their full share of such critical situations, which were successfully handled by new methods. In an address before the Yale Club in New York City recently, Charles M. Jacobs, chief engineer of the Hudson & Manhattan, spoke of a few of the most striking of these problems. They are worth special mention as illustrating the highest type of engineering achievement.

At the beginning of the work on the south tube of the uptown tunnel, the shield from the Hoboken side through the silt was being advanced with the shield doors closed so as to save the cost of excavation. While the heading was still under the Lackawanna coal dock the night superintendent, thinking that the shield was moving very slowly, determined, contrary to orders, to open one of the center doors so as to let the mud come in and so let the shield go ahead faster. The silt shot in under such pressure that it buried some of the men before they could escape; the rest of the shift got away through the upper emergency lock which was then 115 ft. from the shield face. The heading was lost and, the tunnel between the shield and the lock being filled solid with mud, there was no space for air pressure in which men could be put to work digging out the mud. The coal dock was crowded with shipping and, furthermore, the Lackawanna at that time was not particularly favorable to the tunnel enterprise, so it would have been almost impossible to get permission to dredge out the bed of the river in front of the shield so that a diver could go down and timber up the exterior opening to the doorway. The problem was solved as follows: Two heavy mainsails (one being an old one of the cup defender Reliance) were procured and a double canvas cover, about 60 ft. by 40 ft., made of them. Around the edges were secured small weights of pig iron. The canvas was spread on a flat barge and lines carried to fixed points to hold the mainsail in the position; the barge was withdrawn and the mainsail allowed to drop to the bed of the river, 30 ft. of it covering the shield and the remaining 30 ft. extending out beyond the face toward the middle of the river. One of the pipe valves in the lock was then opened and the mud, under the direct pressure of the river, shot into the tunnel westward of the lock for 40 ft. It came in a solid stream for eight days and nights. Finally it let up for a few minutes, began again and then stopped. A cavity had formed in the bed of the river outside the cutting edge of the shield until the canvas dropped with the cavity and was eventually drawn into the opening of the doorway through which the mud was pouring. A small cavity was excavated in the mud-filled tube ahead of the lock and air pressure being put on, it immediately relieved much of the strain on the temporary canvas cover. Miners were then able to get into the tunnel and dig out the mud. In about nine days the heading was recovered and the door on the inside closed.

The north tube is an extension of an old tunnel abandoned some years ago. Within 100 ft. from the point where the shield stopped in the previous attempt, was a reef of rock, standing from 1 to 16 ft. above the intended grade of the tunnel. Before the shield arrived at this point, it was necessary to build a temporary workshop in the river ahead of the shield, so as to build on the front of it a steel apron under which men could work in drilling the rock and blasting it out of the path of the shield. Above the rock was soft silt and, above that, from 60 to 65 ft. of water. It was expected that, in blasting the rock with so slight a cover and with such heavy water pressure, the heading would probably be blown out. Clay loaded on barges was, therefore, always held in readiness to be dumped into any such blowout. After a few weeks the expected blowout occurred and the 900-ft. of tunnel from lock to heading was flooded. The men at work escaped. The clay scows were immediately brought over the blowout and dumped, thus blocking the hole. The water was pumped out into the western workings, and within 11 hours men were able to reach the heading on a small raft. No damage was found and work was soon under way again. In all, only 21 hours time were lost. There were two more blowouts while the tunnel was being built across the 700 ft. of reef, and in each case they were similarly dealt with. Finally, however, there arose a problem which could not be dealt with by dropping these clay blankets. At the extreme eastern end of the reef the rock rises about 16 ft. above the bottom of the cutting edge of the shield. The tunnel at this point is so near the bottom of the river that the clay was almost fluid and continually slipped into the pockets of the shield, so that the men could not get out underneath the apron to drill the rock. Scow after scow was dumped, but the clay would not hold. Finally blow pipe flames, fed from two tanks of kerosene, were directed against the exposed clay until it was indurated, so as to hold its position while the men drilled the rock. The blow pipe process took eight hours, during which time streams of water were continually played on the shield structure to prevent its being damaged by the high temperature. This is probably the first time that man has made brick in the bed of a river.

There was a serious problem on the New Jersey side in regard to the transverse tunnel running from the river tubes north to the Lackawanna terminal and south to the Erie and Pennsylvania terminals, and thence to the downtown tunnel of the Hudson & Manhattan. The problem was to eliminate, as far as practicable, all crossings of the tubes at grade and still give each track a connection with all the terminals mentioned. The south tube of the uptown tunnel was, accordingly, carried under the north tube at the Fifteenth street shaft, Jersey City. About 200 ft. west of this shaft a reinforced concrete caisson (known as caisson No. 1) was sunk from the surface; the caisson is a two-story structure, carrying two tracks on each level. The south tube enters on the lower level, and trains are switched in the caisson to the north or to the south. The north tube comes on the upper level, and branches similarly north and south. The caisson is 105 ft. long, 23 ft. wide at the easterly end, and 46 ft. wide at the westerly end; it is 51 ft. high, is sunk 85 ft. below tide level, and the total weight is about 10,000 tons. There is a similar caisson (No. 2) about 700 ft. west of the first one. In caisson No. 2 trains from Hoboken may be switched over to New York or to the Erie and Pennsylvania stations in Jersey City. Caisson No. 3 is south of caisson No. 2, the three caissons making a triangle. In caisson No. 3 trains from the Erie and Pennsylvania stations are switched either to Hoboken or to New York. It was originally intended to use steel caissons, but the high cost of steel and uncertainty as to the delivery of material resulted in the decision to make them of reinforced concrete with steel cutting edges, being the first of their kind. They were sunk to position and the shields then run into them, making in a unique way underground switch yards, and saving a large amount in cost and in time, the latter being of the utmost importance. It would probably have taken about nine months and cost $75,000 to make one steel caisson. All the caissons were sunk under air pressure.

Perhaps the greatest, though not the most spectacular, feat in all the construction thus far completed was the building of the tunnels at the intersection of Christopher street, Ninth street and Sixth avenue, in Manhattan. From this point two tunnels go east under Ninth street and two north up Sixth avenue. Here there was the elevated railroad overhead, the Metropolitan Street Railway lines on the street surface, and buildings on each side of the street. It was a problem similar to the intersections in Hoboken, just described, but in this case, of course, sinking a caisson was out of the question. To accommodate the two tubes coming up from the south and the four diverging to the east and north it was necessary to build an arch whose maximum width was 68 ft. The work was all in running sand and was done under air pressure. Two iron-lined tunnels were run through this intersection first, and the side-walls then built in. Openings were then made at the tops of the tunnels and timbering for strutting was carried up so that sufficiently heavy false work could be put in for springing the arch. After the arch was completed the two temporary tunnels were taken out. This work required the greatest ingenuity and care for at least eight weeks. Any accident to the timbering, any loss of the necessary air pressure, or any carelessness of the men, would have undoubtedly caused a cave-in, and the elevated structure and the surface lines, together with the streets and the buildings on each side, would have fallen into the excavation. Every square inch of the treacherous ground had to be protected by wooden sheathing the moment it was exposed, otherwise the vibration of the passing trains above would start the sand running. This part of the work was the last of the excavation necessary for opening the railroad to traffic, and although it was early in last December when the spring of this large arch was under way, it was finished so that trains could be operated on February 10, 1908.

Committee Reports at the Maintenance of Way Convention.

Following are brief synopses of the committee reports presented at the convention of the American Railway Engineering and Maintenance of Way Association, held in Chicago this week. An abstract of the discussion of these reports will be given next week.

ROADWAY.

The report on Roadway deals with the subjects of "Track Elevation and Depression in Cities," and "The General Practical Work of Grade and Curve Improvement Work Outside Cities."

Under the first heading, the committee presents, in tabular form a summary of replies received in answer to a circular of inquiry. The roads reporting are the Chicago & Western Indiana; the Burlington; the Rock Island; the Chicago Terminal Transfer; the Delaware, Lackawanna & Western; the Illinois Central; the Long Island; the Michigan Central; the New York, Chicago & St. Louis, and the Pennsylvania. The information included the extent of the work; how it was handled; how it was organized; where the material for filling was obtained; how unloaded; number of cubic yards a day, and the equipment for unloading; method of handling the bridge work, and the methods of handling water, sewer and gas pipes, electric conduits and wires, street cars and general traffic.

The second subject has been confined to the practical work of grade and curve improvement, with particular reference to the consideration of practical methods and organization.

The committee reports progress on the "Determination of Waterway for Culverts," and presents a list of references to articles published on this subject.

The committee recommends the adoption of the following conclusions:

GRADE AND CURVE IMPROVEMENT WORK INSIDE OF CITIES, SUCH AS TRACK ELEVATION AND DEPRESSION.

(1) Organization.—There should be a superintendent of construction in complete charge of the work. To him should report the following officers in charge of the various branches of the work: The engineers having charge of the contract work and giving lines and grades; the roadmaster in charge of earthwork and track work; the engineer in charge of masonry and bridges; the yardmaster in charge of engines and switching; the trainmaster, with a despatcher in charge of the operation of traffic over the territory covered by the work in hand. If the proportions of the work allow, every person connected with this organization should be relieved from all other duties relating to the operation of the road.

(2) The railroad company should handle with its own force all work which may interfere with the operation of the road, such as track raising or lowering, filling and excavating, handling and laying tracks, moving switches and putting in bridges under traffic. All other work which can be done without any interference with the operation of the railroad should be let by contract, both for economical and political reasons; this consisting of street work and concrete work where practicable.

(3) As far as practicable, all earthwork should be handled by machinery; that is, loaded by steam shovels and unloaded by plows, handled by cable unloaders and moved by spreaders.

(4) The best material to use for filling is sand.

(5) Bridge work, both railroad and highway, must ordinarily consist of temporary bridges, to be replaced by permanent bridges after tracks are elevated or depressed.

(6) Water, sewer and gas pipes, electrical conduits and wires should be taken care of and the work of moving them should be done by the companies owning them, whether or not the work is paid for by the railroad company.

GRADE AND CURVE IMPROVEMENT WORK OUTSIDE OF CITIES.

The following rules of practice are recommended:

(1) Establish the lowest gradient and lightest curvature which physical conditions and the present and prospective business of the road will admit.

(2) Complete the location entirely before entering on work of construction.

(3) Attend, first of all, to surface and waterway drainage, and last to the roadway drainage in excavations.

(4) Separate grades of railroads and highways, wherever practicable.

(5) Eliminate temporary bridges, etc., by the substitution of permanent structures in concrete and steel, wherever it can be done, having in view the formation of a continuous roadway on ballast.

(6) Do all light, short haul and preparatory work with teams or other light working plant.

(7) Provide separate tracks for work and traffic, wherever it can be done.

(8) Have a well-defined plan for conducting heavy excavation before tarting work.

(9) The simplest organization is the best. Some one man should be in responsible charge of the work, with a staff of engineers under him, and enough supervisors to cover the work, who have full control of men, material and means for each section, with foremen and gangs everywhere needed.

The report is signed by H. J. Slifer, Chairman; G. H. Bremner, Vice-Chairman; John C. Beye, D. J. Brumley, F. R. Coates, W. M. Dawley, Paul Didier, C. Dougherty, S. B. Fisher, D. MacPherson, W. D. Pence, J. G. Sullivan, J. E. Willoughby and R. C. Young.

BALLASTING.

The committee presents a revision of the ballast sections for crushed rock and slag, Classes A and B, with a slope of 2 to 1. The 1907 convention adopted a rock slope of 1½ to 1, but the committee believed that this was passed under a misapprehension, and therefore submitted the question to letter-ballot. The result of the letter-ballot showed 79 votes in favor of the slope recommended by the committee, and 21 votes against.

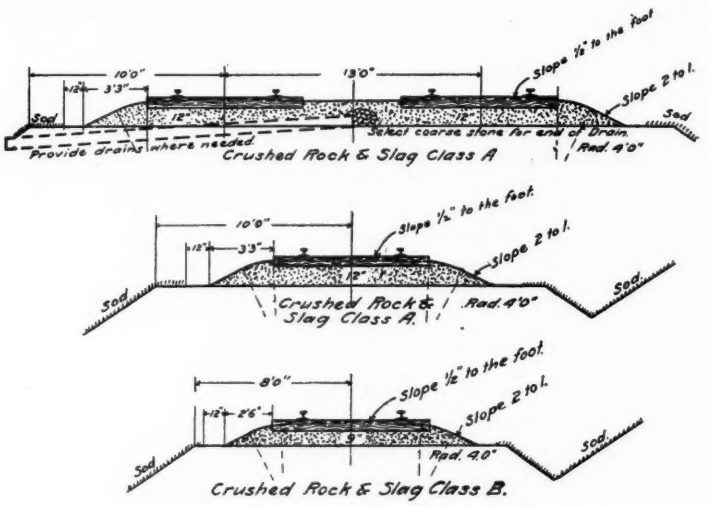
CONCLUSION.

The committee recommends the adoption of the ballast sections for crushed rock and slag, shown herewith, as being good practice.

The report is signed by John V. Hanna, Chairman; C. A. Paquette, Vice-Chairman; Willard Beahan, W. B. Causey, G. D. Hicks, B. C. Milner, F. J. Stimson, G. M. Walker, Jr., W. J. Bergen, J. B. Dickson, Alfred Jackson and A. F. Rust.

TIES.

The report on ties contains a compilation of answers received in reply to a circular of inquiry as to causes of crosstie failure:



NOTE The Slag which should be dressed to section shown for Crushed Rock and Slag, is broken slag, similar in its character to Crushed Rock. Granulated Slag should be dressed to section shown for Gravel, Cinders, Chats, etc.

Crushed Rock and Slag Ballast; Recommended Practice.

whether due to decay, rail cutting or spike cutting; a suggested method for analyzing coal-tar creosote, and determining the amount of zinc in wood treated with that material; a discussion of the future policy of railroads with reference to tie supply, and a list of wood preserving plants in the United States and Mexico.

Conclusions.

The committee recommends the adoption of the following conclusions:

(1) That the method for analysis of coal-tar creosote shown on pp. 98-101 of Bulletin 96 be approved as good practice.

(2) That the method for determination of zinc in treated timbers shown on pp. 102-105 of Bulletin 96 be approved as good practice.

The report is signed by E. B. Cushing, Chairman; W. W. Curtis, Vice-Chairman; E. G. Erickson, W. F. H. Finke, E. O. Faulkner, E. E. Hart, H. C. Landon, J. D. Isaacs, A. S. More, Dr. H. Von Schrenk, J. C. Nelson and H. J. Simmons.

RAIL.

The committee reviews the report of the American Railway Association committee on Standard Rail and Wheel Sections, and points out the desirability of all railroad companies uniting on a single rail section. The American Railway Association committee submitted two series of proposed rail sections, which are shown in the body of the report. (*Railroad Gazette*, Nov. 22, 1907.)

A form for reporting rail failures is submitted for adoption by the railroads represented in the association. The arguments advanced for the approval of the proposed blank are the following:

(1) The desirability of keeping the size of the form to that of a letter-size sheet.

(2) The majority of the railroads of the country require reports of rail failures to be made out by a track foreman, as he is generally the first on the ground after a rail failure, and they will have to depend very largely on him for the information; therefore it seems desirable to put the questions in such a way that men of ordinary intelligence can answer them.

(3) Certain questions were asked by the blank submitted by the American Railway Association committee which were to be answered by reference to diagrams. We believe it better to have

written replies as far as possible to all questions. We have, however, made use of the diagrams showing rail failures suggested by the American Railway Association committee in connection with the instructions on the back of the blank recommended.

Conclusion.

The committee recommends the adoption of form M. W. 1200 for reporting rail failures by the railroads represented in the association.

The report is signed by Wm. R. Webster, Chairman; R. Montfort, Vice-Chairman; F. E. Abbott, J. W. Kendrick, E. F. Kenney, J. Kruttschnitt, E. B. Ashby, A. S. Baldwin, D. D. Carothers, J. A. Colby, C. H. Ewing, S. M. Felton, J. F. Hinckley, Robert W. Hunt, D. W. Lum, F. H. McGuigan, H. T. Porter, J. T. Richards, R. Trimble, G. W. Vaughan, H. U. Wallace and G. B. Woodworth.

TRACK.

The report on Track embodies formulas and tables for computing the elements of the split switch (straight points) from a tangent. A diagram showing a 15-ft. reinforced split switch was presented. For main track, the committee recommends split switches in accordance with the diagram, with distant switch signal interlocked with switch-stand and pipe-connected derail. The bolted type of frog is recommended, the length to be such that the standard angle bars can be applied; flangeway to be 1⅞ in.; rails to be of open-hearth steel, fillers to be made of rolled steel and to fit snug; bolts of fine B. B. iron, round and true to size, with U. S. standard ends and threads; bolt holes to be accurately drilled, holes to be made $^1/_{16}$ in. less in diameter than bolts to be used; parts of frogs to be then assembled and holes reamed in order to be straight and of such size as to give the bolts a driving fit. Bottom plates to be made of rolled steel. A plan of the proposed frog was shown on the diagram.

The guard rail recommended is 15 ft. long, with flangeway 1⅞ in. where track is maintained to standard gage. If turnouts are located on curve, it is recommended that flangeway be widened to maintain a distance of 4 ft. 6⅝ in. from the gage of frog to the gage of the guard rail.

The diagrams and formulas for the widening of gage were prepared for the standard spacing of wheels of consolidation engines. The tables given are for consolidation engines having 18 ft. wheel base, consolidation engines having 19 ft. wheel base, and decapod engines having wheel base of 19½ ft. In making the calculations, the distance from back to back of tires for forward and rear drivers is assumed to be 53⅛ in., and for middle drivers 54¼ in. The clearance between the hubs of the wheels and the driving boxes is taken as 1¼ in. The committee recommends to the American Railway Master Mechanics' Association that the present clearance between wheels and driving boxes for new and repair work be increased from ⅛ to ¼ in.

Conclusions.

The committee recommends the adoption of the following conclusions as representing good practice:

(1) That the elements of the split switch turnout from a tangent be computed according to the formulas given and as indicated by Table No. 1.

(2) The adoption of the reinforced split switch shown.

(3) The adoption of the frog and specifications for same, outlined in the body of the report.

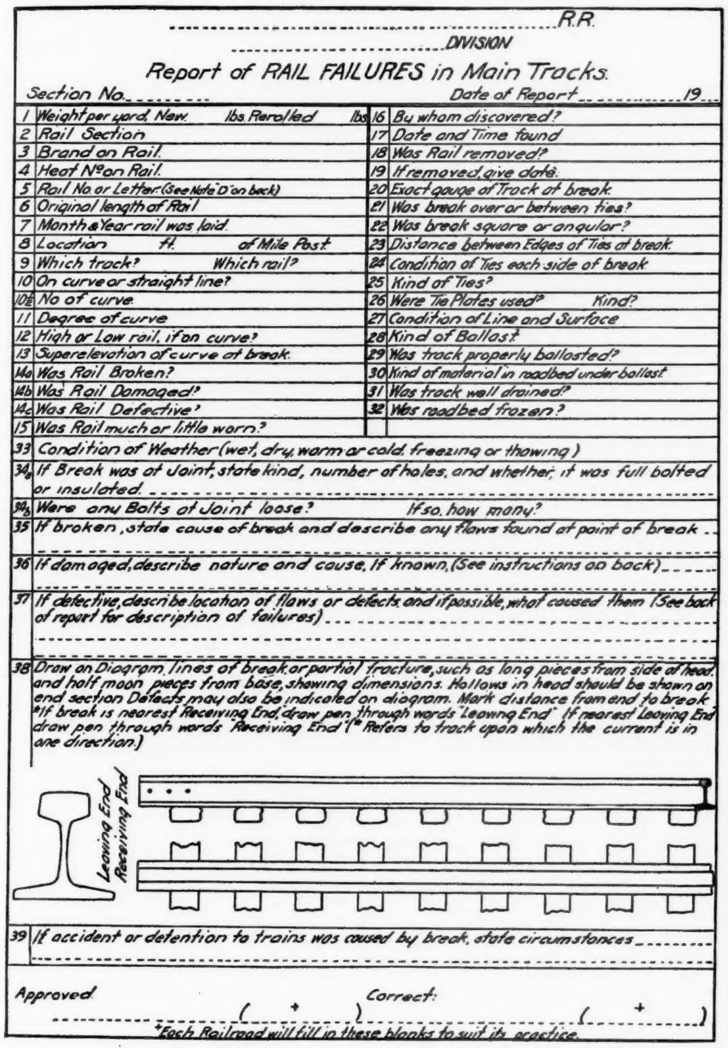
(4) The adoption of the guard rail and throat clearance, shown with the 15 ft. reinforced split switch.

(5) That tie-plates be used on all ties throughout the leads.

(6) That glazed sewer pipe with bell ends be used for the drainage of wet cuts, pipe to be laid without cemented joints, and to be covered with hay or straw and cinders, and laid below frost line where possible. French or pillar drains to be used for the curing of slides.

(7) That the widening of gage on curves be calculated according to formula on diagram A in the report, like tables B, C and D.

The report is signed by L. S. Rose, Chairman; T. H. Hickey, Vice-Chairman; Wm. Ashton, R. K. Brown, G. C. Cleveland, A. L. Davis, Garrett Davis, R. L. Huntley, W. S. Kinnear, C. E. Kimkerbocker, R. K. Rochester, F. A. Smith, Earl Stimson, R. A. Van Houten and A. A. Wirth.



................................R.R.

................................DIVISION

Report of RAIL FAILURES in Main Tracks.

Section No.......... Date of Report.............19...

1	Weight per yard, New. lbs. Rerolled lbs	16	By whom discovered?
2	Rail Section	17	Date and Time found
3	Brand on Rail.	18	Was Rail removed?
4	Heat No. on Rail.	19	If removed, give date.
5	Rail No. or Letter. (See Note "D" on back)	20	Exact gauge of Track at break.
6	Original length of Rail	21	Was break over or between ties?
7	Month & Year rail was laid.	22	Was break square or angular?
8	Location ft. of Mile Post	23	Distance between Edges of Ties at break.
9	Which track? Which rail?	24	Condition of Ties each side of break
10	On curve or straight line?	25	Kind of Ties?
10½	No. of curve.	26	Were Tie Plates used? Kind?
11	Degree of curve	27	Condition of Line and Surface
12	High or Low rail, if on curve?	28	Kind of Ballast.
13	Superelevation of curve at break.	29	Was track properly ballasted?
14a	Was Rail Broken?	30	Kind of material in roadbed under ballast.
14b	Was Rail Damaged?	31	Was track well drained?
14c	Was Rail Defective?	32	Was roadbed frozen?
15	Was Rail much or little worn?		

33 Condition of Weather (wet, dry, warm or cold, freezing or thawing)

34a If Break was at Joint, state kind, number of holes, and whether it was full bolted or insulated.........

34b Were any Bolts at Joint loose? If so, how many?

35 If broken, state cause of break and describe any flaws found at point of break........

36 If damaged, describe nature and cause, if known, (See instructions on back).........

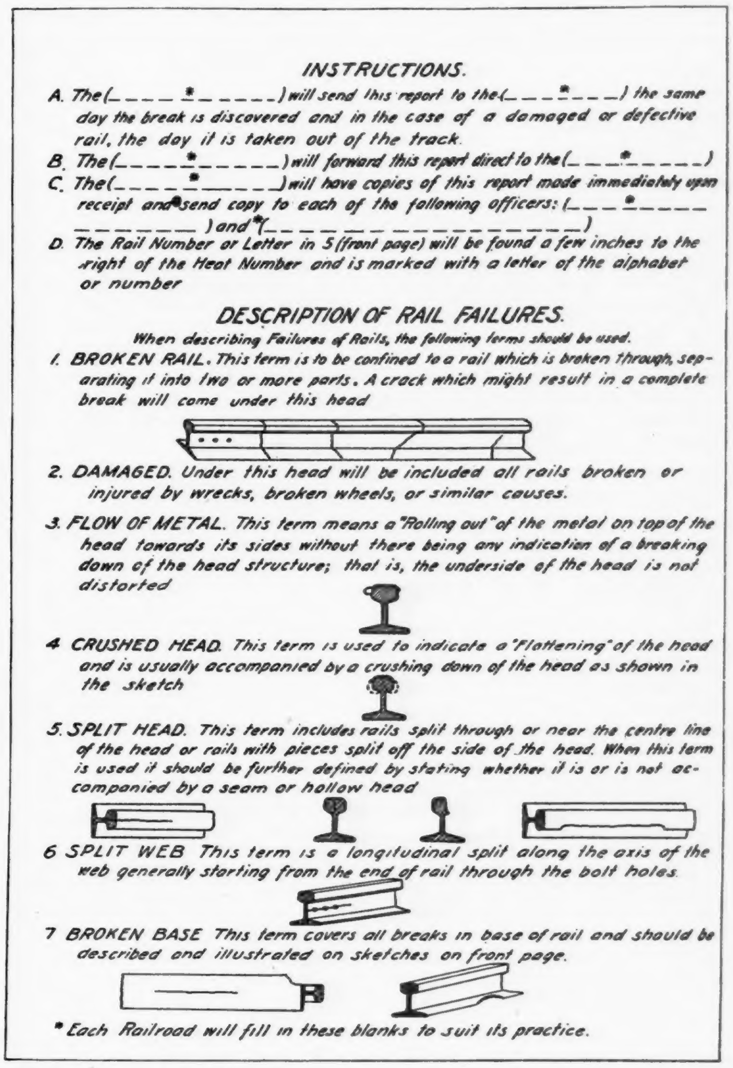
37 If defective, describe location of flaws or defects and if possible, what caused them (See back of report for description of failures).........

38 Draw on Diagram lines of break or partial fracture, such as long pieces from side of head and half moon pieces from base, showing dimensions. Hollows in head should be shown on end section. Defects may also be indicated on diagram. Mark distance from end to break. *If break is nearest Receiving End, draw pen through words "Leaving End." If nearest Leaving End draw pen through words "Receiving End." (* Refers to track upon which the current is in one direction.)

39 If accident or detention to trains was caused by break, state circumstances.........

Approved: ....(*) Correct: ....(*)

*Each Railroad will fill in these blanks to suit its practice.



INSTRUCTIONS.

A. The (____*____) will send this report to the (____*____) the same day the break is discovered and in the case of a damaged or defective rail, the day it is taken out of the track.

B. The (____*____) will forward this report direct to the (____*____)

C. The (____*____) will have copies of this report made immediately upon receipt and *send copy to each of the following officers: (____*____) and *(________)

D. The Rail Number or Letter in 5 (front page) will be found a few inches to the right of the Heat Number and is marked with a letter of the alphabet or number

DESCRIPTION OF RAIL FAILURES.

When describing Failures of Rails, the following terms should be used.

1. BROKEN RAIL. This term is to be confined to a rail which is broken through, separating it into two or more parts. A crack which might result in a complete break will come under this head

2. DAMAGED. Under this head will be included all rails broken or injured by wrecks, broken wheels, or similar causes.

3. FLOW OF METAL. This term means a "Rolling out" of the metal on top of the head towards its sides without there being any indication of a breaking down of the head structure; that is, the underside of the head is not distorted

4 CRUSHED HEAD. This term is used to indicate a "Flattening" of the head and is usually accompanied by a crushing down of the head as shown in the sketch

5. SPLIT HEAD. This term includes rails split through or near the centre line of the head or rails with pieces split off the side of the head. When this term is used it should be further defined by stating whether it is or is not accompanied by a seam or hollow head

6 SPLIT WEB This term is a longitudinal split along the axis of the web generally starting from the end of rail through the bolt holes.

7 BROKEN BASE This term covers all breaks in base of rail and should be described and illustrated on sketches on front page.

* Each Railroad will fill in these blanks to suit its practice.

Recommended Form for Reports of Rail Failures.

BUILDINGS.

The subjects assigned the committee were as follows:

(1) Report and present recommendations relative to best type of locomotive coaling station to adopt for various conditions.

(2) Report on use of reinforced concrete for roundhouses.

(3) Report on best method for smoke removal, ventilation and heating of roundhouses.

(4) Report on use of movable or fixed cranes for facilitating locomotive repairs in roundhouses.

(5) Report on best arrangements of windows and roof lights and proper ratio of light area to floor surface in roundhouses.

Under the first heading, the committee submits its conclusions,

as follows (conclusions 1 to 4 were adopted in 1907, but are reproduced for convenience in discussion):

(1) The cost items should include charges for interest and depreciation, charges for maintenance and operation (the cost of switching cars onto trestles should be included), and a charge for the use of cars for storage purposes.

(2) Provision should be made for fire protection, the avoidance of damage to the coal, and its delivery in the best possible condition.

(3) The use of self-clearing cars should be made possible, and ordinarily it should also be possible to shovel from flat-bottomed cars.

(4) Storage for emergency purposes and fireproof construction are, in general, to be recommended, and in some cases duplicate machinery is desirable.

(5) It is not possible to give absolute limits between which different types of coaling arrangements are to be used. Each installation must be considered as an individual problem. Prices of materials, cost and character of labor, the possible track arrangements, the amount of storage desired, the power and attendance, and shifting service available, all are to be considered.

(6) Where the quantity of coal handled is small, particularly at terminal points where locomotives lie over night, it is recommended that the locomotives be coaled, either directly from cars by the hostler, or by handling from cars to an elevated platform provided with a jib crane and one-ton buckets, and from these buckets to the locomotive.

(7) At terminals where the daily consumption of coal does not exceed 75 tons, a locomotive crane with clam-shell bucket is desirable, provided that there is at such terminal other work that can be economically performed by the locomotive crane.

(8) At terminals where the requirements are from 75 to 200 tons per day and a deep foundation is practicable, a "balanced two-bucket hoist type" of coaling station is recommended.

(9) For terminals larger than those previously considered, the type of coaling station which should be selected as most desirable is dependent entirely upon local conditions. Where it is required that coal be delivered to not more than two tracks, and where the necessary ground space is available, a coaling station of the "trestle type," with incline approach, is recommended. In yards where delivering locomotives are constantly in attendance a plant with a 5 per cent. incline is preferable to one with a 20 per cent. grade operated by a hoisting engine. Where it is required to deliver coal to more than two tracks, or where the ground space for a "trestle type" is not available, a "mechanical conveyor type" is recommended.

(The following substitute for conclusions 8 and 9 is submitted by a member of the committee as a minority report.)

(8) At terminals where the requirements do not exceed 200 tons a day, when the desired storage is not so great that auxiliary buckets are necessary, and where a deep foundation is practicable, a two-bucket hoist is recommended.

(9) At points where the requirements are greater than this a mechanical conveyor plant is recommended, except that when the track arrangement and the ground space available permit, especially where it is difficult to obtain proper care of a mechanical plant, the use of a trestle should also be considered.

Under the second heading, "Use of Reinforced Concrete for Roundhouses," the following conclusions are submitted:

(1) Reinforced concrete should be used below the floor when it is cheaper than plain concrete.

(2) The additional security against interruption to traffic warrants the construction of a roundhouse with a reinforced concrete roof.

(3) When the roof is of reinforced concrete the columns should be of the same material.

(4) Reinforced concrete should be used for the walls only where special conditions reduce its cost below that of brick or plain concrete and where plaster is not considered satisfactory.

Subject No. 3—"Best method for smoke removal, ventilation and heating of roundhouses"—no definite recommendation is made.

Subject No. 4—"The use of movable or fixed cranes for facilitating locomotive repairs in roundhouses"—the conclusion of the committee is that:

Jib cranes attached to the posts alongside of a number of pits in roundhouses, or, in the case of large roundhouses, a small traveler working around the outer circle, capable of handling two tons should be installed, in such roundhouses as may be designated by the motive power department as requiring such appliances for light locomotive repairs.

Subject No. 5—"Best arrangement of windows and roof lights, and proper ratio of light area to floor space"—the committee concludes that:

(1) The disadvantages of roof or skylights in roundhouses are so much greater than their advantages as to make them undesirable.

(2) Windows in the outer walls of roundhouses should be made as large as practicable and contain the largest glass or light area consistent with the requisite strength. In general, the lower sill should be not more than 4 ft. from the floor and only sufficient space left between pilasters and sides of window frames, and girders and window heads to properly secure the window frames. Windows or transoms as large as practicable should be provided over all doors where locomotives enter.

The report is signed by O. P. Chamberlain, Chairman; Maurice Coburn, Vice-Chairman; J. W. Cowper, H. M. Cryder, C. H. Fake, J. S. Metcalf, A. G. Norton, L. D. Smith, Wm. Graham, E. W. Wiggin, C. H. Stengel, S. D. Brady, M. J. Caples and W. H. Sellew.

WOODEN BRIDGES AND TRESTLES.

The report on Wooden Bridges and Trestles contains standard specifications for bridge and trestle timber; revised specification for piling; a discussion of wooden trestle bridges with ballast floors, including plans typical of the two general designs for ballast floor trestles in use on the Santa Fe, Illinois Central, Mobile & Ohio, and Union Pacific railroads; safe unit stresses for timbers used in wooden bridges and trestles, with a graphical comparison and tables of unit stresses; a discussion of preservation of structural timber, its effect on the strength of timber, cost of treatment, method of treatment, etc.; specifications of the Santa Fe for creosoting Pacific coast piling and timber; standard names for structural timbers and classification of southern yellow pine.

Conclusions.

The adoption of the following conclusions is recommended:

(1) That the standard specifications for bridge and trestle timbers be approved as good practice.

(2) That the revised specifications for piling be approved.

(3) That there be added to the definitions of standard defects of structural timber the following:

16. *Ring Shake.*—An opening between annual rings.

17. *Through Shake.*—A shake which extends between two faces of a timber.

The report is signed by Henry S. Jacoby, Chairman; James Keys, Vice-Chairman; F. H. Bainbridge, A. L. Bowman, R. D. Coombs, R. T. Darrow, H. G. Fleming, Hans Ibsen, S. S. Roberts, W. F. Steffens, I. O. Walker, C. C. Wentworth and B. A. Wood.

MASONRY.

The specifications for stone masonry, presented in 1907, have been revised and are submitted for final approval.

The committee was instructed to report on the most economical size or combination of sizes of stone to be used in stone concrete, as applied to the different classes of work. A circular of inquiry was issued, requesting an expression from the members of the association as to their preferences, and a summary of the replies is given in the report. From the answers received the committee draws the following conclusions:

"Considering plain concrete only, and assuming that the aggregate will range in size from ¼ in. to the maximum named, a preference is shown for the following maximum sizes:

"For foundations, 2½ in.; for abutments, 2 in.; for arch rings, 1½ in.; for coping, bridge seats and thin walls, 1 in."

The committee reports progress on the subject of waterproofing masonry, and on the subject of failures of concrete structures.

A comparison of standard plans in use on a number of railroads for masonry culverts is in preparation, and will appear in a bulletin after the convention.

The report is signed by A. O. Cunningham, Chairman; C. W. Boynton, Vice-Chairman; W. B. Hanlon, W. K. Hatt, H. H. Knowlton, C. H. Moore, W. H. Petersen, Job Tuthill, J. W. Schaub, Richard L. Humphrey, F. B. Scheetz, G. F. Swain and G. H. Tinker.

SIGNS, FENCES AND CATTLE GUARDS.

The committee reports progress on the subject of "snow fences, snow sheds and other means of preventing snow accumulating and the best methods of clearing tracks and snow removal." A large amount of valuable information has been obtained in response to a circular of inquiry, and a report will be made on the subject during the coming year.

The report is signed by W. D. Williams, Chairman; F. P. Gutelius, Vice-Chairman; L. G. Curtis, Ole Davidson, A. E. Doucet, Paul Hamilton, C. W. Pifer, W. A. Wallace and H. F. White.

SIGNALING AND INTERLOCKING.

The report contains an historical review of the efforts made by various railroad companies towards formulating an ideal system of signaling, and the committee briefly summarizes the requirements thus far adopted by the association and published in the Manual of Recommended Practice.

The committee has developed and presents the indications deemed requisite, with their application, shown by means of a diagram, and from which it has deduced the necessary requisites of installation and adjuncts.

Requisites of installation for telegraph block, controlled manual, automatic block and other systems are given. The requisites of installation recommended depart from the Standard Code of the American Railway Association in six important features:

(1) A distinctive position is recommended for the caution indication of the distant signal, in lieu of a special form of arm displayed in stop position of other signals.

(2) Two lights are recommended on every signal in lieu of one, two, three, four or even five lights under present practice.

(3) The requisite use of two lights is taken advantage of in distinguishing between the different types of signals.

(4) A differentiation is made between signals requiring stop until authorized to proceed, stop and proceed, and stop and investigate, because the first two have been provided properly and necessarily by the standard code, and the third one is recognized in universal practice and should be embodied in the rules laid down for the proper conduct of transportation.

(5) A differentiation is made between the indication regulating the approach to another signal and the indication permitting a train to enter a manual block that is not clear.

(6) Adequate approach indications are provided for all high-speed signals.

The following arguments are advanced for the adoption of the committee's plan:

(1) The advantages resulting from uniformity of signaling on the different systems of the country are:

(a) A considerable mileage of track in the country is operated jointly by two or more roads, and at present if the signal practices of the parties to the joint use of tracks are at variance, as frequently occurs, the same crews may have to run under different systems of signaling on a single run. Under a uniform system these crews would have but one system of indications to learn.

(b) Men leaving the employment of one road will not have to unlearn one system of signaling and learn another in order to qualify to work upon another road.

(c) Uniformity of indications will tend to uniformity in a considerable portion of the apparatus used, resulting in a decrease in various manufacturing expenses, and amount of stock to be carried by manufacturers and railroads, especially at jointly operated plants, and will result in quicker delivery of material.

(d) The expense for damage claims should be reduced and a better legal status secured to the railroad companies on account of less liability to confusion of indications, and on account of the system of signaling proposed having the endorsement of general adoption.

(2) Quicker and more accurate interpretation of signals by enginemen.

(3) Indication of diverse functions by the signals themselves, instead of by general orders, special orders, etc., thus relieving the enginemen's minds of a burden of detail.

(4) Classification of indications of the same general meaning, thus avoiding misunderstanding.

(5) Information by the aspect of the signal of the improper display of an indication.

The report also contains three papers by members of the committee, on "Signal Indications and Aspects, " and "Suggestions as to the Selection or Development of a Basis for a Correct System of Signaling."

Conclusions.

(1) The committee recommends that the "requisite indications," as shown on page 12 of Bulletin 94, are adequate and embody all essential and proper indications and that they be recommended to the American Railway Association for adoption.

(2) That the "requisites of installation" set forth on pages 11-17 of Bulletin 94 are practicable and form an adequate and proper basis for the design of a system of aspects required for the display of the requisite indications and are essential for a uniform, universal system of signaling, and that they be referred to the American Railway Association for adoption as proper for new work and renewals.

The report is signed by A. H. Rudd, Chairman; L. R. Clausen, Vice-Chairman; Azel Ames, Jr., C. C. Anthony, H. S. Balliet, Chas. A. Dunham, G. E. Ellis, M. H. Hovey, J. C. Mock, F. P. Patenall, J. A. Peabody, Frank Rhea, W. B. Scott, Thos. S. Stevens, J. E. Taussig, H. H. Temple, H. M. Waite and Edwin F. Wendt.

RECORDS, REPORTS AND ACCOUNTS.

The report on Records, Reports and Accounts contains a review of the subjects of Right-of-Way and Track Maps and Individual Ledger Accounts. Three blank forms are submitted—Form M. W. 1,020, Monthly Progress Statement of Expenditures; Form M. W. 1,014, Standard Method for Recording the Cost of Individual Pieces of Work; and Form M. W. 1,017, a suggested substitute for the Estimate Form shown in the Manual of 1907.

The following conclusions are submitted for adoption:

RIGHT-OF-WAY MAPS.

Definition: "Right-of-Way Map.—A plat representing the actual location and dimensions of all property, rights or franchises that are owned or controlled by a railroad company."

(1) Right-of-way maps should show the state, county, township, town or city; the right-of-way alinement complete; the station plusses of the crossing of all important land or property lines and streets, with the distance to all permanent land or street corners. The angle which the center line of the road makes with property lines; the number of the right-of-way sheet; the points of the compass; the scale and date of the map; the boundaries of the several parts of the land owned by the company, and the width of the right-of-way, particularly at those points where the widths change; any additions, or subdivisions of towns or cities, with numbers and sizes of lots and blocks, and names of streets. It should also show all main tracks, sidetracks and structures that were built in connection with the original construction of the road; the exact location of all crossings of steam, electric or other roads.

(2) On or near each part of the land on the right-hand side of each map should be shown the deed custodian's number; the date of grantor and grantee, mileposts, kind of instrument, date and book and page where recorded. This also includes reference to leases, franchises, ordinances and grants concerning the use of land.

(3) The original right-of-way map should be traced, and the tracing filed away for a permanent record of the conditions existing at the time the railroad was completed. The map from which this tracing is made should be corrected from time to time as changes are made in important tracks and structures, which are of value as reference to the right-of-way boundaries, as well as any transfers of property made to and from the railroad company, and any important tracks or structures.

(4) The property of adjacent railroads or of subsidiary and associated companies should be shown in different colors for the purpose of ready distinction.

(5) It is important to show on the original right-of-way map a profile of the same horizontal scale and of the same station numbers as the map and of suitable vertical scale, which profile should show the original subgrade, the location, character and size of opening of each bridge, waterway or under-crossings, and the original surface of the ground, the necessity for this being the knowledge of physical conditions at the time the road was built, often needed in defending litigation and settling questions arising from time to time.

(6) In regard to the scale, size and methods of filing maps, it is not considered advisable to make a definite recommendation as to the scale of such maps, because of the different conditions that require greater or less detail. It is suggested, however, that a range of from 50 ft. to the inch to 400 ft. to the inch should cover all possible conditions, except, possibly, in undeveloped portions of the country, where a smaller scale could be used.

TRACK MAPS.

Definition: "Track Map.—A map used primarily for showing physical conditions, including tracks, bridges, buildings, water service and mains, leases, station facilities and all of the physical and operating features."

(1) Track maps should show all physical conditions pertaining to the construction and operation of the railroad and the limits of the right of way without reference to title or ownership. They should show all main and sidetracks and their alinement, distance between them, capacity and car lengths; all buildings upon the right of way and adjacent thereto. dimensions and character thereof and location with reference to main or sidetracks; bridges, culverts, water stations, coaling plants, turntables, shop buildings, water mains, electric light wires, fences, street car and other railroad crossings, and the angle they make with the railroad track; sewers, signals of all kinds and all physical conditions on the property. All structures on such maps should be located by chainage numbers and plusses.

(2) They should be corrected whenever any changes are made in any of the features shown thereon and a corrected copy sent to the general office for record.

(3) It is recommended that a scale of 100 ft. to the inch be used for such maps except in territories and cities of large industrial development, where varying scales may be used to suit the local conditions.

(4) The map should show very plainly the north point, scale, original date and date corrected.

(5) The conventional signs adopted by the association should always be used where it is possible and convenient to do so.

INDIVIDUAL LEDGER ACCOUNTS.

(1) The adoption of form M. W. 1020, to be used for a monthly progress statement of expenditures (p. 55, Bulletin 97).

(2) The adoption of form M. W. 1014 as a standard method for recording the cost of individual pieces of work, such form to be used in making a report to the officer in charge of the department doing the work (p. 54, Bulletin 97).

(3) Your committee recommends for consideration, and, if possible, approval, a suggested change for form M. W. 1017 (pp. 56, 57, Bulletin 97).

The report is signed by H. R. Safford, Chairman; J. B. Austin, Jr., Vice-Chairman; W. Archer, Edward Gray, Henry Lehn, A. W. Newton, J. E. Schwitzer, V. D. Simar, R. C. St. John, J. E. Turk, and E. K. Woodward.

UNIFORM RULES.

The committee submits for adoption the following rules pertaining to supervisors of signals:

(1) They shall report to and receive instructions from the (To be filled in by each road).

(2) They shall be responsible for the safe condition and proper maintenance of all signals and interlocking plants in their districts. They must inform themselves of the condition of signals and interlocking plants, make necessary repairs of such defects as

may endanger or delay the movement of trains, and promptly report defective condition to (Title).

(3) They shall employ, in the discharge of their work, such men as are necessary for carrying out the duties for which they are responsible.

(4) They must know that all foremen are provided with all rules, circulars, forms and special instructions pertaining to their duties, and that they fully understand and comply with the same.

(5) They must see that all foremen are familiar with the rules in regard to train signals and flagging, and that they fully understand and comply with the same.

(6) They must know that all foremen are supplied with tools and material necessary for the efficient performance of their duties and must see that they are properly cared for and used.

(7) They shall conform to the prescribed standards and plans in the execution of the work under their charge.

(8) They shall not permit experimental trials of appliances or devices not standard with the company, nor give out information of the results of any trial, except by proper authority.

(9) They shall keep general oversight of all work performed in their districts by contractors or others who do not come under their direct charge, and see that nothing is done by them that will interfere with the safety of track or movement of trains.

(10) They must make frequent inspections of all signals and interlocking plants in their districts and have necessary repairs made as promptly as conditions require.

The report is signed by R. C. Barnard, Chairman; J. H. Abbott, Vice-Chairman; C. C. Anthony, Robert Bell, C. N. Kalk, F. L. Nicholson, J. O. Osgood, J. C. Mock, J. A. Peabody, G. H. Webb, and C. A. Wilson.

WATER SERVICE.

This committee took for the subject of its report a revision of the conclusions previously adopted by the association on the "Quality of Water, with Methods of Treatment and Results Obtained Therefrom." The matter appearing in the Manual of 1907 under the above heading has been rearranged, condensed and a portion eliminated.

Conclusions.

The committee recommends that the material in the "Manual of Recommended Practice," edition of 1907, be revised to read as follows:

QUALITY OF WATER, WITH METHODS OF TREATMENT AND RESULTS OBTAINED THEREFROM—CONCLUSIONS AND RECOMMENDED PRINCIPLES OF PRACTICE.

(1) In locating water stations along a railroad, an investigation should be made of all the available water supplies, and care should be taken to avoid the use of poor water, or to curtail its use as much as possible.

(2) Most water used in locomotive boilers contains scale-forming matter in solution or suspension, causing much trouble and expense in operating and maintaining locomotives.

(3) Hard water can be softened before it is put into locomotive boilers by treating it with chemicals.

(4) Water whose hardness is due to carbonates of lime and magnesia can be softened at a moderate expense for chemicals by the use of lime alone, without adding any soluble salts to the softened water.

(5) Water whose hardness is due to sulphates of lime and magnesia can be softened, but at a greater expense, by the use of soda ash, a more expensive chemical. In this case soluble sulphate of soda will be added to the softened water, increasing the tendency to foam.

(6) The mechanical methods of modern water-softeners are new and differ widely, but consist of two general types, the continuous and the intermittent.

(7) At stations where hard water is used, special study should be made relative to the economical value of treating the water, and the method best adapted to meet the conditions.

(8) The cost of installing a water-softening plant varies according to the capacity of the plant, its type, cost of material and labor in its locality, and other local conditions.

(9) The cost of operating a water-softening plant varies according to the efficiency of the water-softening apparatus and the cost of lime and soda ash, or other chemicals available for softening water in its locality.

(10) The cost of chemicals required to soften water varies according to the quantity of hardening matter in the water, and also its composition.

(11) The benefits derived from water-softening plants are: Fewer boiler failures due to leaking; longer life of flues and firebox sheets; reduced cost of labor for repairing and washing boilers; increased locomotive mileage between shoppings; decreased number of locomotives required to perform the same service; less expense in cost of overtime and delayed time.

(12) The removal of the sulphates of lime and magnesia is of greater value than the removal of the carbonates alone, as the carbonates of magnesia, without the presence of the sulphates of lime or magnesia, do not form hard scale, but are precipitated in the boiler as soft scale and mud.

(13) The greatest disadvantage in treating water is the increased tendency to foam, due to the reaction of soda ash on the sulphates of lime and magnesia.

The report is signed by A. K. Shurtleff, Chairman; W. P. Boright, J. L. Campbell, John P. Congdon, J. P. Haliihan, E. N. Layfield, C. A. Morse, John P. Ramsey, C. L. Ransom, G. J. Ray, O. E. Selby and M. H. Wickhorst.

YARDS AND TERMINALS.

The report on Yards and Terminals deals with the subjects of Freight Yards for Hump Switching; Track Scales; Conveying Car Riders in Hump Yards; Yard Lighting; Freight Transfer Station; Railway Freight Houses and Warehouses, and Freight Handling Machinery.

Plans and profiles of a number of gravity switching yards are shown; also plan of entrance to classification yard, with double ladders; plans of freight transfer stations; illustrations of freight conveying machinery in use at ocean terminals; tables giving car capacities of freight yards on the Pennsylvania Lines; track scales in freight yards on various railroads; methods adopted for weighing cars, and descriptions of railroad freight houses and warehouses at Newark, N. J., and Pittsburgh, Pa.

Conclusions.

The committee recommends the following changes in conclusions, and the recommended principles of practice:

HUMP YARDS.

(1) Hump yards should consist of receiving, classification and departure tracks, in consecutive order.

(2) A hump yard is a desirable form of yard for receiving, classifying, and making up trains, because cars can be handled through it faster and at less cost than through any other form of yard.

(3) Receiving tracks should be of sufficient length to hold maximum trains of the various classes handled.

(4) Receiving tracks should be sufficient in number to hold a number of trains arriving in quick succession. The number will depend on the amount and character of traffic handled, and upon the relative location of the yard with respect to the other yards and connections.

(5) If it is possible, the grades of the receiving tracks should be such that one engine can push the maximum train over the hump.

(6) No definite recommendation can be made as to length or number of classification tracks, except that when they are to be used as departure tracks they should be long enough to hold full trains, and that when conditions permit, there should be as many of them as can be used to advantage to avoid subsequent classification and consequent delay.

(7) Departure tracks should be full train length and of sufficient number to provide ample standing room for trains while being tested for air, and while waiting for engines.

(8) An air brake testing plant should be provided in the departure yard; the tracks should be piped, and sufficient outlets furnished with hose to test air brakes on all outgoing trains.

(9) To secure the greatest possible efficiency or to so construct a hump that the greatest number of cuts of cars may be classified over it, the steepest part of the grade should be reached in the least available distance after passing the summit, and the grade or fall should provide sufficient momentum to carry all cars to lower ends of classification tracks.

(10) Where cars to be classified are largely empty or light, and the scale is on the hump, grades are recommended for average conditions as follows:

The summit of the hump should be reached by vertical curves with radius of about 1,500 ft. that raise the grade about one foot in a distance of 60 ft.; the curve over the summit to be continued on the descending grade a distance of about 30 ft. to join a grade not exceeding 2 per cent. for a distance not exceeding 60 ft. Thence descending by a vertical curve with radius of about 2,000 ft. a distance of 40 ft.; thence descending on a grade of 4 per cent. a distance of 50 ft.; thence descending by a vertical curve with radius of about 5,000 ft. a distance of about 155 ft. to join a grade of 1 per cent. at the heads of the ladder tracks. Thence down through ladder tracks and turnouts, 1 per cent.; thence down through classification tracks, 0.5 per cent.

(11) Where cars to be classified are largely heavy or loaded, and the scale is on the hump, the same grades are recommended for use over the hump as for light cars, but as the proportion of light cars diminishes the length of the grade of 4 per cent. may be reduced.

It is recommended, however, that the length of the 4 per cent. grade be at least 25 ft.; that the grade of ladder tracks be at least 0.8 per cent., and that the grade of classification tracks be at least 0.4 per cent., where conditions permit.

(12) Where traffic or climatic conditions require, the summit of a hump may be made higher in the winter and restored when the increased height is not needed.

(13) When required by traffic conditions, a track scale not exceeding 60 ft. in length should be located at such a distance from the summit of the hump (30 to 40 ft. is recommended) that when cars to be weighed reach the scale they will be properly spaced from following cars and will be running slowly enough to easily secure correct weights. The grade over the scale should not exceed 2 per cent.

(14) For average conditions it is recommended that No. 8 frog be the sharpest used in classification yards.

YARD LIGHTING.

(1) For yard lighting the use of arc lamps of 2,000 candle-power is recommended.

(2) For lighting hump and ladder tracks, the lamps should be spaced 140 to 150 ft. apart and hung 28 ft. (or more) above the tracks.

(3) For lighting body tracks, the spacing should be such that cars will be clearly visible.

FREIGHT TRANSFER STATIONS.

(1) Freight transfer stations should be located at points where traffic converges or diverges, or both, and where necessity exists for its consolidation of separation.

(2) The installation should provide for the greatest possible economy of operation, both as to time and cost of handling.

(3) Where fixed platforms are used, they should be covered, and it is recommended that the width under ordinary conditions be not more than 24 ft., and that the tracks on either side be built in pairs. If greater facilities are required, additional platforms 8 ft. in width may be provided outside of the first two tracks and additional tracks placed outside of them. The width of these additional platforms may be 8 ft. if without roofs, or 12 if covered by roofs supported by a line of posts in the middle.

(4) Where large amounts of freight are to be transferred, the use of power-driven covered traveling platforms, instead of fixed platforms, is suggested.

FREIGHT HANDLING MACHINERY.

(1) The use of freight handling machinery at railway freight houses, warehouses and shipping piers is worthy of consideration.

The report is signed by F. S. Stevens, Chairman; E. E. R. Tratman, Vice-Chairman; E. P. Dawley, A. C. Everham, A. P. Greensfelder, F. G. Jonah, Paul Jones, B. H. Mann, J. D. Mason, A. Montzheimer, G. F. Morse, H. J. Pfeifer and M. E. Shire.

IRON AND STEEL STRUCTURES.

The report on Iron and Steel Structures embodies a discussion of Inspection, Reports and Records of Bridges, and Classification of Bridges as to Safe Carrying Capacity.

Under the heading of Inspection, the committee recommends the following plan:

INSPECTION.

(1) *Daily*, by trackmen, who, in connection with the inspection of track, shall examine every bridge, with the object of discovering any change in condition or movement of super- or substructure, damage from drift, high water, falling objects, broken or loosely hanging bars or members, broken or badly damaged ties, missing bolts or nuts.

(2) *Monthly*, by competent bridgemen, who shall examine every member and every part of the super- and substructure of every bridge whose inspection is not governed by Article 3, with the object of detecting cracks, wear of parts, loose bars or members, loose rivets, excessive deterioration, crushing or breaking of the masonry, scouring or undermining of foundations and any defects whatsoever. They shall carefully observe the action of the structure under traffic, with the object of directing any new, unusual or excessive motion.

(3) *Quarterly*, by competent bridgemen, who shall inspect, in the manner and with the object as defined in Article 2, those good and substantial bridges which shall be particularly designated by the proper officer.

(4) *Annually*, by an experienced bridge inspector, who shall with thoroughness examine in detail the condition of every part of the super- and substructures. The object of this inspection is to obtain a check on the monthly and quarterly inspections, a report on the *extent* of defects, deterioration, motion, etc., from which may be determined the degree of safety of the structures, the necessity for repairs and extent of strengthening and renewals required.

(5) *Annually*, by the authorities in charge of bridges for the purpose of officially deciding the *extent* of reinforcing, renewals or traffic restrictions which must be made during the following year.

(6) In addition to the foregoing, the following special inspections should be made, as occasion may require:

(a) Of all structures which are severely strained or show signs of distress under traffic.

(b) Of all substructures which show signs of movement, until the movement ceases, or the conditions causing it have been remedied.

(c) After heavy freshets for evidence of damage to superstructures by drift and to substructures by scour.

(d) By the engineering department whenever a structure is reported as requiring "extensive" repairs or renewal.

Reports.

The following reports are considered necessary by the committee:

(1) It is not necessary for trackmen to make reports unless something wrong is discovered, in which case the proper authorities should be immediately notified, in order that necessary measures may be taken to insure the safety of the bridge.

(2) Bridgemen making monthly and quarterly inspections should report on each structure each time examined. These reports should cover briefly all the items outlined in Article 2, under the heading of Inspection, as well as any other items shown on the printed forms.

(3) The annual report, by experienced bridge inspectors, should be complete in detail, as it will form the basis from which will be determined the degree of safety of the structures, the necessity for repairs and the extent of strengthening and renewals required.

(4) In addition to the foregoing, reports should be made of all special inspections.

Records.

The following records are deemed essential to show a complete history of structures:

(1) General drawings of bridge sites, showing alinement of tracks, span lengths, skews, etc., with all necessary profiles. When the structure is over a stream, the profile of the river bottom should be revised from time to time, to show the rate of scour and condition of foundations.

(2) Set of strain sheets and detail drawings of the superstructures, preferably on tracing cloth.

(3) Detail drawings of the substructures as actually built, showing all information relating to the foundations.

(4) Copies of all specifications, contracts, tests of material and inspector's shop and mill reports.

(5) Records of all repairs, repainting, renewal of ties, etc.

(6) Copies of the annual inspection reports, kept up to date by frequent revisions.

(7) Tabulated statement of all clearances, covering the traffic through, under or over the structure.

(8) Copies of all documents relating to the work, such as special legislative acts, licenses, findings and awards of commissions, agreements relating to the sharing of cost of construction, maintenance, etc.

(9) Complete calculations and schedules, showing classification of the bridges as to their safe carrying capacity.

(10) For convenience of reference in the office, it is advisable to make a synopsis of the above information on cards or loose sheets. This should include:

(a) Name and location of the structure.
(b) Character of crossing.
(c) Spans, skew, height above rail, clearances, high-water mark, number and alinement of tracks.
(d) Brief description of the super- and substructure.
(e) Specifications under which structure was built
(f) Quality of materials.
(g) Date of building and name of builder.
(h) Details of timbering.
(i) Abstracts of inspection reports.
(j) Records of painting and repairs.

(11) In addition to the above, each division officer and inspector should have a list containing every bridge coming under his supervision, and copies of all inspection reports pertaining thereto.

Classification of Bridges.

The subject of Classification of Bridges has been subdivided into (1) carrying capacity, and (2) classification for operating purposes.

Under the first subdivision, the committee offers the following conclusion:

(1) The *carrying capacity* of a bridge is here understood to mean the heaviest moving loads which may be operated over it in regular service for a limited time without subjecting it to such severe strains, motion or wear of parts as to seriously impair its safety and serviceability.

(2) The carrying capacity of any bridge will depend upon a large number of controlling factors, all of which must be taken into consideration. Some of these factors are design, material, workmanship, speed, strains, behavior, physical condition and the possibility of maintaining falsework for a considerable time should the bridge show distress under increased loading.

(3) A railroad bridge which has been constructed in accordance with a specification which provides for strength, design, material and workmanship at least equal to the standard of the American Railway Engineering and Maintenance of Way Association specifications will, when in good condition, carry for a limited period a loading in excess of that for which it was originally designed. The bridge, however, will be subjected to a greater amount of motion and wear of parts, have a lower margin of safety, less efficiency and a shorter life.

(4) When the span is less than 200 ft., all controlling factors

given in Article 2 good, the mathematical analysis made in accordance with the American Railway Engineering and Maintenance of Way Association specifications of 1906, using full specification allowances for impacts for regular service fast speed and one-half of these impact allowances for slow speed, then, so long as the controlling factors remains good, unit strains in tension to the extent of 26,000 lbs. in structural open-hearth steel and 22,000 lbs. in wrought iron, will not, in themselves, be sufficient justification for suspending traffic or condemning the structure.

(5) When the controlling factors as outlined in Article 2 are not good, the limiting strains or capacities cannot be determined by any general rule, as they are questions of actual conditions, judgment and experience, supplemented by a close watch on the structure in service.

Under the second heading, classification for operating purposes, the committee advances the opinion that bridges should be classified according to their efficiencies under a loading of the type outlined in the association's specifications; that the efficiencies should be indicated by figures representing either the total weight or driving-axle weight of the heaviest permissible engine of the specification type, and that these figures should be placed on the map of the railroad in such a manner as to show at a glance the capacity of the weakest structure on the main line, branches and engine districts. A schedule on the map giving the service classes of engines and cars whose operation is permitted by the stated efficiencies is recommended. Notes on the map would indicate restrictions as to speed and double-headers. The scheme outlined is illustrated by a map and schedule.

IMPACT TESTS.

The convention of 1907 by vote authorized the inauguration of a series of experiments to determine the effect of moving loads on railroad bridges, and the committee on Iron and Steel Structures was entrusted with the work of conducting the tests. A fund was provided to defray the expenses of making the experiments, and the work commenced during the summer of 1907.

A sub-committee, composed of Prof. F. E. Turneaure, University of Wisconsin; C. H. Cartlidge, Bridge Engineer, Burlington Railway System, and Prof. C. L. Crandall, of Cornell University, were appointed to take charge of the work.

Twelve instruments were constructed at the shops of the University of Wisconsin, with which the experiments were made. The first bridges tested were on the Illinois Central Railroad; subsequent tests were made on the Chicago, Burlington & Quincy; Chicago, Milwaukee & St. Paul; Chicago, Rock Island & Pacific, and New York, Chicago & St. Louis railroads. The results of these tests are embodied in a preliminary report, published in Bulletin 97, pp. 13-25. The experiments will be resumed next summer.

The report is signed by J. E. Greiner, Chairman; C. F. Loweth, Vice-Chairman; M. F. Brown, C. H. Cartlidge, C. L. Crandall, B. W. Guppy, A. J. Himes, Charles M. Mills, A. D. Page, C. D. Purdon, A. F. Robinson, C. C. Schneider, J. P. Snow, F. E. Turneaure and J. R. Worcester.

OPEN VERSUS BALLAST DECK STRUCTURES.

By A. F. Robinson, Bridge Engineer, A., T. & S. F. System.

The object of the author is to demonstrate that it is more economical to use ballast deck structures than open decks, and presents comparisons as to cost of the two types.

Formulas giving the distribution of the wheel loadings of the various kinds of decks are embodied in the paper.

The author assumes a life of 28 years for creosoted ballast decks on metal bridges and seven for the untreated pine used in open decks on metal bridges. He also assumes 24 years as the average life of creosoted ballast deck pile bridges and eight years as the average life of ordinary open deck pile bridges with soft wood timber and piles untreated.

The author has given in the paper in itemized form the total cost and the average annual cost per lineal foot of track for various kinds of decks, which he has designated by numbers. Following is a summary:

	Per lin. ft. of track— Total cost.	Avg. an'l cost.
Open deck No. 1	$23.40	$0.86
" " " 2	27.46	.95
" " " 3	30.62	1.03
" " " 4	34.12	1.10
" " " 5	41.70	1.32
Ballast deck No. 6	18.19	.66
" " " 7	21.18	.74
" " " 8	.....	.76
Open deck pile bridge No. 9	46.43	1.79
" " " " " 10	58.03	2.12
" " " " " 11	53.43	1.99
Ballast deck pile bdge No. 12($19)	50.62	1.82
Ballast deck pile bdge No. 12($20)	53.18	1.90
Reinforced concrete plan No. 13	.....	1.67
Plan No. 13, average $30 per ft.	.....	1.83
Ballast deck No. 6-A	21.93	.76
" " " 7-A	26.68	.85
" " pile bdge plan No. 14	63.43	2.23

In presenting the foregoing comparisons for various structures, the author recognizes the fact that any great variation in market prices for material or labor may show decidedly different results.

Conclusions.

The advantages of the use of ballast deck structures, in the opinion of the author, are given in the following conclusions:

(1) Ballast to a large extent absorbs or dissipates and distributes the effect of impact in such a manner as to materially increase the life of structures.

(2) Ties will not "bunch" in good stone or gravel ballast, and this kind of floor gives increased safety in case of derailment.

(3) It almost entirely prevents accidental fires that can catch from falling coals, thereby rendering insurance unnecessary.

(4) It gives a more nearly perfect riding track, there being no breaks in ballast from beginning to end of division.

(5) It gives an increased feeling of safety to the traveling public, to the trainmen and operating officials.

(6) It gives a more stable structure in time of high flood.

(7) By the use of ballast floor structures we are enabled to use the poorer or second grades of timber, thereby tending to reduce the great and dangerous drain on our visible supply of first grade material.

In final conclusion, the writer believes ballast deck structures are advisable from all points of view; that they should be used on bridges of all kinds, both on main and branch lines, and believes the time not far distant when open deck structures will be ancient history.

The Signal System of the Interborough Subway

In a report on the signal and interlocking system in use in the New York subway, Bion J. Arnold, Consulting Engineer, has recommended to the Public Service Commission that improvements be made in the signal apparatus by which less headway for express trains may be obtained without sacrificing the safety of passengers, and that after these improvements are perfected the local tracks be equipped with the same block signal system as is now used on the express tracks. The signal changes he recommends would make possible a headway of 90 seconds, or 40 trains an hour, on both express and local tracks. At present the rate is about 30 trains an hour.

Mr. Arnold declares the existing signal system as complete as it was possible to make it at the time it was put in (1904), but says that the art of signaling has made rapid strides since that time. According to the records furnished him by the Interborough company for the two years from October 1, 1905, there were 155,064,894 signal and stop operations with 497 failures, or one failure to 312,001 of block and interlocking signal and automatic stop movements. This he considers a satisfactory test of the signal system in use, but he believes that with new methods and appliances perfected since the installation of the system, it can be greatly improved.

"Although the original installation of the signal system," says Mr. Arnold, "was such that safety was obtained at all points, the congestion due to the long delays at the station platforms caused changes to be made in the station blocks on the express tracks. These changes were based upon the assumption that a reduction in speed would be made when trains approached stations, and it therefore follows that safe automatic control of trains is not now always obtained. In other words, the motorman's intelligence and judgment, as well as his physical condition now entered as a factor in the safety of train movements, particularly when approaching stopping stations. To maintain a uniform standard of safety over the entire system, it is necessary to introduce some device that will insure this reduction in speed when approaching the stopping point."

Several observations were made of the movement of trains in the subway. The highest observed speed was 40 miles an hour. The usual speed of express trains at places favorable for fast running was 35 miles an hour. Heavily loaded northbound express trains leaving the Brooklyn Bridge made 32 miles an hour. At the Grand Central Station, where observations were confined to the movement of trains at express platforms, the number of trains moved an hour was 27 northbound and 29 southbound, and the average time interval between the arrivals of trains was 2 minutes and 12 seconds northbound and 2 minutes and 1 second southbound. The average length of stop was 58 seconds northbound and 35 seconds southbound. The shortest stop was 25 seconds on both tracks and the longest stop was 82 seconds on the northbound and 62 seconds on the southbound track.

Summing up these observations, Mr. Arnold concludes:

"These figures show the average length of time required for the trains to pass from Grand Central Station block and indicate that under present conditions it is hardly possible to maintain a two-minute headway upon the express tracks during rush hours. A two-minute headway corresponds to the rate of 30 trains an hour, whereas trains were passed through this station at the rate of only 27 trains an hour northbound at night, and at the rate of 29 trains an hour southbound in the morning rush hours."

There is a special signal placed just outside of each express

station which operates to prevent approaching trains from running into a train standing at the station. Since the system was installed this stop signal has been brought nearer the station platforms for the purpose of reducing the delay in trains stopped by it, and thereby increasing the capacity of the express tracks. Inasmuch as the alertness and attention of the motorman are relied upon to prevent collisions, Mr. Arnold thinks that some automatic device should be added so as to make the safety absolute in the case of signals at express stations. Final changes in the present system should move the automatic stop further away from the platform rather than closer to it. The existing system with its automatic safety trip insures absolute safety on the express tracks between stations, and it should be important to provide the same degree of safety in the station blocks by means of automatic stops.

Speaking of the design of the express stations, Mr. Arnold says:

"The subject of the proper design of express stations will be discussed in another report, but it is proper to state here that, had the express stations been constructed from the beginning, by being double decked or otherwise, so that trains could have been alternated first on one side of the platforms and then on the other, the capacity of the subway could have been increased at least 50 per cent. with the signal system as originally installed, but as this was not done it seems necessary under present conditions to revise the present signal system to the greatest extent practicable consistent with safety in order to secure capacity.

As a temporary means of increasing the efficiency of the existing signal system, Mr. Arnold suggests a visual and audible signal to be given by a stopped entering train to a subway platform station attendant that it has been delayed to the extent of a full stop. He also suggests a manually operated switch, whereby an attendant can release the emergency stop holding the entering train and give it the signal to proceed after the leaving train has begun to move. Much time is now lost, he says, because the proceed signal is not given to the motorman of the entering train until the last car of the leaving train has left the platform.

In regard to the signal system for the local tracks, Mr. Arnold says that the only difference between train movements on the different tracks is that more frequent stops are made by local trains. As the introduction of more frequent stops between the terminals introduces a risk, the need for safety signals on the local tracks is really greater than it is on the express tracks. It would therefore appear that if the practical degree of safety decided upon for subway operation demands the installation of the signal system and automatic stopping devices on the express tracks, the same or similar equipment is necessary on the local tracks.

As the local and express trains alternate on the same tracks north of 96th street, it is desirable that the same headway should be maintained on both systems south of 96th street. As far as the signal system is concerned, there is nothing to interfere with such an arrangement up to the capacity of the express tracks which can eventually be operated with a headway of 90 seconds, corresponding to 40 trains an hour, although it cannot be denied that the introduction of the block signal system on the local tracks will thus reduce their present possible capacity from 50 trains an hour to 40 trains an hour. Inasmuch as there are now being operated on the local tracks during rush hours only about 30 trains an hour, it will be seen that the block signal system can be installed upon these tracks and at the same time allow an increase in the number of trains of 33⅓ per cent. over the present number."

Mr. Arnold's conclusions are:

(1) The subway signal system is in the main, modern, effective and well maintained.

(2) There is no reason so far as the signal system is concerned why a 90-second headway cannot be maintained.

(3) This 90-second headway will eventually be desirable upon both local and express tracks.

(4) The signal system at the present time does not afford positive safety at the approach to stations, as the motormen are relied upon to reduce the speed of the trains.

(5) In addition to the excessive platform waits additional time is lost at each station stop by holding the following train a considerable distance out of the station until the leaving train has entirely cleared the platform.

(6) As at present operated delays at the station platform have a cumulative effect upon the following trains, so that even one prolonged stop may disarrange the schedule for the entire hour.

The report recommends the following changes:

1. That the necessary steps be taken to develop and install an automatic speed control signal system to be used as an auxiliary at station blocks, which will allow the incoming train to safely approach the rear of the train at the platform and to enter the platform promptly upon the leaving of the outgoing train without sacrificing any of the standard of safety which is now maintained between stations.

2. That during the development of the system there be installed at every express station the changes in the block signal system proposed by the Interborough company for Grand Central Station. The equipment required for these changes will reduce the present possible headway by 7 seconds, and could ultimately become a part of the permanent recommended arrangement.

3. That the subway officials consider for the purpose of effecting temporary relief the installation of a manually operated permissive signal at every express station to be used to expedite a delayed incoming train and thus overcome the cumulative effects on the schedule of a prolonged station wait.

4. That the local tracks be protected by a complete block signal system when the automatic speed control system herein suggested has been perfected.

5. That, when the load on the subway increases to such an extent as to require additional conductors for carrying the electrical energy to and from the trains, the present signal system be altered so as to use both rails for carrying the return current, and at the same time make the system conform to the latest accepted practice whereby the signal system detects and indicates a broken or removed rail, provided the system shall at that time have proven superior to the single-rail system.

The Failure of the Quebec Bridge.

The Royal Commission appointed by the Canadian government to inquire into the cause of the collapse, on August 29, 1907, of the Quebec bridge, has recently published its report which is dated February 20, 1908. The scope of the inquiry was described and the summarized findings of the Commission published in the *Railroad Gazette* of March 13, 1908, page 383. The Commissioners were Henry Holgate, C.E., of Montreal; John G. G. Kerry, C.E., of Campbellford, Ont., and John Galbraith, Dean of the Faculty of Applied Science and Engineering and Professor of Engineering in the University of Toronto.

The Commission acknowledges its great indebtedness to the following gentlemen: Charles Macdonald, formerly Chief Engineer of the Union Bridge Company, contractor for the superstructure of the Memphis cantilever bridge; H. W. Hodge, of Messrs. Boller & Hodge, engineers of the Monongahela cantilever bridge; Ralph Modjeski, of Messrs. Noble & Modjeski, engineers of the Thebes cantilever bridge; Colin M. Ingersoll and Henry B. Seaman* of the Department of Bridges of the city of New York, and Messrs. Reynders and Kunz, of the Pennsylvania Steel Company, respectively the engineers and the contractors for the superstructure of the Blackwell's Island cantilever bridge; Prof. Mansfield Merriman, Prof. W. C. Kernot, Prof. W. H. Burr, Prof. Edgar Marburg, Prof. H. M. MacKay, Prof. G. F. Swain, and Messrs. W. R. Webster, T. K. Thomson and W. W. Stern, Consulting Engineers; also "the hearty co-operation of all officials of the companies directly concerned. Messrs. Cooper, Szlapka, Deans and Hoare especially have made every effort in their power to assist us to establish the facts and have not attempted to spare themselves."

Most of the Commission's discussion of the difficulties that arose during erection of the bridge and of events at the time of its collapse, including the correspondence between the interested persons immediately preceding the catastrophe, follows:

The contract for the construction of the main spans was made conditionally on June 19, 1903, and finally accepted by the Phoenix Bridge Company on March 15, 1904. By the 1st of August, 1904, the assembling of materials for the falseworks on the south shore had commenced, and by the beginning of September, 1904, the erection of the falsework was well under way. The wooden falsework for the supply tracks, and the steel falsework for the traveler and bridge trusses were erected simultaneously, not quite one-half of the falsework being put up before December 1, 1904. The erection of the big traveler was commenced, and the storage yard at Chaudiere was in working order before the end of the season of 1904.

A considerable amount of material was delivered at the Chaudiere yard during the succeeding winter, but the work was not pushed in the spring of 1905, because there was no rail connection between the bridge site and the Chaudiere yard. This connection was completed on July 9, 1905, at which time the framework of the big traveler was being completed, and the falsework had been erected to the main pier but was not finished.

The equipment of the traveler was installed and the erection of the steelwork was begun at the anchor pier on July 22, 1905. By the middle of September the lower chords of the anchor arm had been erected, the pedestals and feet of the center posts were being placed and the erection of the web members and upper chords had commenced. By the end of the season six panels of the anchor arm, out of a total of 10, were in place. The total amount of metal erected during 1905 was about 10,500,000 lbs.

In 1906, erection commenced on April 16 and the south anchor arm was all in place, except for some decorative details, by June 27. Erection continued on the south cantilever arm and this was completed with the exception of some connecting pieces between it and the suspended span, before work closed down for the year, on No-

*Mr. Seaman is now Chief Engineer of the New York Public Service Commissioner, First District.—EDITOR.

vember 26. The total weight of metal erected during this season was about 21,000,000 lbs. Work on the north shore commenced about the middle of July and a small portion of the falsework was in position by the end of the season.

During this season few difficulties occurred, and these were of a kind usually met with on all large work. The following quotation from Mr. McLure's report to Mr. Cooper, under date of July 21, 1906, gives a fair idea of the conditions existing on the work: "The whole policy of the Phoenix erection department seems to be to make things safe and take no chances, which is a very satisfactory one to us, and in pursuance of this everything is being bolted up full in cantilever arm, with the largest size bolts the holes will take, post and chord splices, main and sub-diagonal splices as well as all lateral and transverse bracing connections."

The Commission has been unable to satisfactorily determine the respective duties of Mr. Hoare and Mr. Cooper. According to Mr. Deans, Mr. Cooper had to approve all plans, but all other authority was vested in Mr. Hoare, and this opinion Mr. Deans continued to hold throughout the work. According to Mr. Parent, Mr. Hoare was practically an executive officer acting in all technical matters on the direction of Mr. Cooper, who was, *de facto*, Chief Engineer. Mr. Cooper himself has stated that the erection plans were not subject to his authority and has disclaimed any responsible connection with the inspection either in the shop or in the field. With few exceptions, all his directions are advisory and not imperative, and he seems to have endeavored throughout to avoid encroaching on the privileges and rights properly pertaining to Mr. Hoare's position. He gave frequent directions to both Mr. McLure and Mr. Edwards on technical matters, but throughout the construction period (August, 1905 to August, 1907) he had practically no correspondence with Mr. Hoare. Mr. Cooper's opinions, when given, were accepted by the inspectors as instructions. The impression left with us is that throughout the work Mr. Cooper was in a position of a man forced in the interests of the work to take responsibility which did not fully belong to his position, and which he was not authorized to take, and that he avoided the assumption of authority whenever possible. Such an organization cannot from an executive standpoint be considered entirely satisfactory.

Work for the season of 1907 began in March, it being necessary to have a yard prepared to receive material on the north shore by early spring. The yard was located at Belair, close to the junction of the Canadian Pacific and the [projected] National Transcontinental Railway. Work on the trusses began on May 1, but until May 31 was confined mainly to riveting. Using the big traveler, the connecting links between the cantilever arm and the suspended arm were put in, and the small traveler was built. On July 13 the erection of the suspended span was commenced, the small traveler being used and the dismantling and removal of the big traveler was begun. Both of these operations were in progress when the bridge fell, on Thursday, August 29. On the north shore, work continued at a leisurely rate from about May 15 until the day of the accident. The north shore falsework was not fully erected by that date, there being no reason to hurry, because rail connection could not be obtained. During this season less than 3,000,000 lbs. of metal were erected. The last progress estimated (August, 1907) showed that about 34,400,000 lbs. in all had been erected.

The difficulties with the lower chords that finally resulted in the collapse of the bridge were noted early in the season, but those first observed were considered to be of minor importance.

On June 15 Mr. McLure reported to Mr. Cooper as follows:

> In riveting the bottom chord splices of south anchor arm, we have had some trouble on account of the faced ends of the two middle ribs not matching as per following sketch. (The sketch shows that at the lower sides the middle ribs of the abutting chords were out of line by ⅛-in. to ¼-in., this offset decreasing to nothing near the mid depth of the ribs.) This has occurred in four instances so far and by using two 75-ton jacks we have been able to partly straighten out these splices, but not altogether. These were probably in this condition when erected, but owing to the presence of the bottom cover plate, it was then impossible to detect them, and it was only when this plate was removed for riveting that the inequality was noticed. The chords found in this shape were between 3 and 4, 7 and 8, and 8 and 9 in east truss, and 8 and 9 in west truss. You will note that this occurs only on inside ribs, which are provided with but a single thin splice plate each. I think that a heavy plate on each side of these ribs, bolted up tight when chords were erected, would have remedied this, *i. e.*, drawn the ribs together till the "faced ends matched."

Mr. Cooper replied on June 17 saying:

> Make as good work of it as you can. It is not serious. It would be well to draw attention to using as much care as possible in future work to get the best results in matching all the members before the full strains are brought upon them.

It should be noted that of the four joints mentioned, those between chords 3 and 4 and 7 and 8 had originally been opened at the lower side and had come together by "camber" movement; but the 8 and 9 joints had been set with the lower edges abutting. During the first stages of erection, the upper edges of all the ribs at a joint were exposed to view, as the upper cover plate was not in place. Mr. Kinloch states in his evidence that he observed gaps between abutting ribs as great as $^1/_{32}$ in. due to irregular finish of the planed ends of the chords. In the examination of the material in Belair yard the Commissioners found irregularities of workmanship which would account for the conditions described above, and in our judgment these could have been avoided only by matching the chords together in the shop previous to shipment. The small gaps between abutting ends of chords closed as the pressure on the chords increased, with no result other than producing irregularity of stress, but the lateral deviations had to be corrected by the use of jacks.

As Mr. Cooper, in his evidence, has expressed the opinion that these lower chord joints were, during erection, the weakest and most hazardous part of the structure, and that they suffered from lack of appreciation of the necessary care to be given them, it is advisable to closely review all evidence concerning them.

The chords consisted of four deep and narrow ribs latticed together and finished with square ends so that the pressure might be transmitted from one chord to the next by contact of the abutting ends. Under the system of erection adopted it was possible to place the adjoining chord ends in contact only at either the upper or lower edges, and it was expected that the chords would gradually turn during the settlement of the bridge until the end surfaces came fully in contact. This expectation was realized. The adjoining chords were held together by eight splice plates; an upper and a lower horizontal plate, two vertical plates on each outside rib and one vertical plate on each inner rib. The order of erection required that the lower plate should be put in position before the next chord was set; the vertical plates were next placed, and the erection of the joint was finished by bolting on the upper plate. Owing to erection angle at the joint it was possible to use full size bolts on only one horizontal plate and one edge, either upper or lower, of each vertical plate.

The instructions with regard to the bolts were very definite and read as follows: "All bottom chords to have two-thirds of all holes of web splices filled with 1-in. bolting on the outer ribs, and ⅞-in. bolts on the inner ribs, or their equivalent in smaller bolts or drifts. For top splice plate apply rule (1), (this requires that every hole shall be filled with a bolt) and never take off splice plate again, not even while driving rivets in web splices. Bottom splice plate to be bolted with bolts two-thirds value. While driving rivets in web splices of chords, remove bottom splice plate and bolt across flanges temporary angles to keep flanges in place." Owing to the camber openings at the joints it was found necessary in some cases to use ⅝ in. bolts, as no larger bolts could enter the holes in their erection condition.

The evidence shows that these instructions were carried out but not with a full appreciation of their importance. Mr. Birks, who was admitted by all witnesses to have been an exceptionally accurate and painstaking inspector, examined all the bolting towards the end of the season of 1906 this examination being made on direction of Mr. Deans, and at the express request of Mr. Reeves, the President of the Phoenix Bridge Company. He reported as follows:

"All bottom chord splices in anchor arm—top plate full—bottom plate and webs 67 per cent.—all joints bolted as per instructions," and also "all chords in the first five panels of the cantilever arm top plate full—rest 67 per cent."

Mr. McLure's report about bolting has already been quoted, and Mr. Kinloch, in his evidence, states that the Phoenix Bridge Company's instructions about bolting were fully obeyed but that he personally did not pay much attention to the bolting of the bottom cover plate as he knew that it had to come off during riveting. We are of the opinion that the top and bottom cover plates and the splice plates for the outside ribs, all of which could be readily seen by the inspectors, were correctly bolted, but there may have been some cases of insufficient bolting on the inside ribs. Such cases were, we think, rare.

It was intended that, as the camber openings closed, the smaller bolts should be taken out and replaced by larger bolts on all outside plates, the inner plates being difficult of access until the bottom chord plate was removed. This idea does not seem to have been followed in practice to any extent nor is there any evidence to show that the bolting was systematically tightened up as it worked loose with the adjustment of the structure. The evidence also shows that the bottom cover plates were left off during the whole period of riveting a joint (usually from ten days to two weeks), and that in the case of 7-8 L cantilever arm this plate was off for nearly the whole month of August, 1907. We must therefore conclude that the splice plates at the joints were rather loosely attached and that the importance of rigidity at these points were strangely overlooked.

It should be noted that this system of bolted splices was a necessity due to the method of erection adopted, but that there was no reason why the end details of the chords and the splice plates themselves should not have been much more strongly and rigidly designed. The erection problem was unique in magnitude, particularly in the camber requirements, and the method followed by the Phoenix Bridge Company closely corresponds to that in general and successful use on smaller structures. It is open to criticism on theoretical grounds and it is possible that other engineers might,

by other design serve the same ends; the problem in its dimensions is so entirely new, that there is room for much study and invention in erection methods for great structures.

We know of no reason why the method adopted cannot be successfully used, but the evidence shows that the Phoenix Bridge Company failed to appreciate the important influence that end details and splices had on the strength of the chords. Steps were not taken to insure that the work was so handled that the maximum rigidity consistent with design was secured at these joints. Considering the circumstances, we know of no good reason why the riveting should not have been much further advanced before the great stresses created by the erection of the suspended span were thrown upon the joints. The report of Mr. McLure on November 10, 1906, shows that all but eight of the 40 lower chord joints were then closed and ready for riveting. Mr. Cooper has clearly stated that he did not consider that the erection methods were subject to his control, although the evidence shows that he was frequently consulted about them, both by Mr. Szlapka and by Mr. McLure. The erection problem in this case was of great importance, and the Quebec Bridge Company did not place their interests under the direct and responsible control of an experienced engineer acting solely on its behalf.

Difficulties developed almost as soon as the erection of the suspended span got well underway. On August 6 Mr. McLure reports as follows:

New Liverpool, P. Q., Aug. 6, 1907.

Mr. Theodore Cooper, Consulting Engineer, 45 Broadway, New York.

Dear Sir:—In riveting up the splice between chords 8 and 7 in the west truss of south cantilever arm we found the condition of the inside ribs at splices as indicated in following sketch. Owing to the limited space between the two inside ribs, it would be impossible to jack this splice back, and as the condition is not nearly as bad at the top of the splice, we have proposed putting a diaphragm between the two inside ribs to cover the first five rivets up from the bottom on each side of the splice, as indicated in red in the sketch above. The splice plates being riveted on the two inside ribs, it will be necessary to cut out and re-drive twenty rivets to do this. This provision, together with the top and bottom cover plates, should be sufficient to hold this splice against the thrust due to its being out of line, which thrust when under its maximum compressive stress I estimate at not over 60,000 lbs.

The Phoenixville office is being notified of this plan, and if they will approve will wire us. If this also meets with your approval or if you wish to suggest another way to remedy the difficulty, will you please wire me at St. Romuald, P. Q., care Phoenix Bridge Company, as the riveting gangs are ready to finish riveting this splice. Very truly yours,

N. R. M'LURE.

On receipt of this letter, Mr. Cooper wired the Phoenix Company as follows, August 8:

New York, Aug. 8, 1907.

Phoenix Bridge Co., Phoenixville, Pa.:

Method proposed by Quebec for splicing joints of lower 7 and 8 chords is not satisfactory. How did bend occur in both chords?

THEODORE COOPER.

and wrote Mr. McLure on August 9 as follows:

New York, Aug. 9, 1907.

N. R. McLure, Esq., Inspector for erecting Quebec Bridge, Liverpool, P. Q.

Dear Sir:—Yours of the 6th, regarding bent condition of lower 7 and 8 chord joints, came yesterday. I wired Phoenix that the proposed method as sketched by you for repairing was not satisfactory. Also asked, what you should have reported, how did both these chords get bent?

In my opinion these webs can be brought back to proper line by use of 15 to 20 1-in. bolts, threaded at both ends for nuts, passing through the two webs of that half of chord. Of course, means must be taken to stiffen the straight web against its bending when the bolts are tightened.

If necessary, after getting the bent web in line, to hold them, spacers and possibly some through bolts may be used.

Some more satisfactory method than the one shown in your sketch must be devised.

Mr. Deans telegraphs that upon Mr. Szlapka's return he will give me fuller facts. Yours truly,

THEODORE COOPER.

Then the following telegram was received from Mr. Deans:

Phoenixville, Pa., Aug. 9th, 1907.

Theodore Cooper, Consulting Engineer, 45 Broadway New York:

Mr. Szlapka happened to be at bridge site yesterday—expect him home tomorrow, with full information concerning chord joint, will then write you fully.

JNO. STERLING DEANS.

To which Mr. Cooper replied as follows:

New York, Aug. 9, 1907.

John Sterling Deans, Chief Engineer, Phoenix Bridge Co., Phoenixville, Pa.

Dear Sir:—Your telegram regarding chord joint at hand. The method proposed as sketched by Mr. McLure is not satisfactory, as I telegraphed yesterday.

These bent webs can be pulled back by use of about 15 to 20 1-in. bolts (in $1^1/_{16}$-in. holes) threaded at both ends for nuts, passing from the outer to the inner bent web, the outer straight web being stayed in some manner against its bending.

If the bent webs after being pulled into line, tend to go back when released from the bolts, stays must be introduced to hold them in position. Possibly it may be necessary to permanently rivet in some of these 1-in. bolts.

Please let me know what method you propose to use.

It is a mystery to me how both these webs happened to be bent at one point, and why it was not discovered sooner. Yours very truly,

THEODORE COOPER.

On August 10th, Mr. Deans wrote to Mr. Cooper as follows:

Dear Sir:—"Splice cantilever chords 7 and 8." Mr. Szlapka did not return to-day as expected, but will no doubt be here on Monday, when we will write you at once. Yours truly,

JNO. STERLING DEANS.

And on the 12th Mr. Deans again wrote to Mr. Cooper as follows:

Dear Sir:—Chord splice south cantilever arm, 7-L and 8-L.

Mr. Szlapka reached the office this morning and I am able to give you information in connection with this one joint.

All ribs of the chord 7-L have a complete and full bearing on ribs of 8-L. The bend was no doubt put in the rib in the shop, before facing and was probably done when pulling the ribs in line to make them agree with spacing of these ribs and the clearance between ribs, called for on the drawing. The bend being on only one rib of one chord, there being a full bearing over the entire rib, all splice plates being readily put in position, we do not think it necessary to put in the diaphragm, suggested by the erection department.

Please let us hear from you on this subject promptly, and oblige,

Yours truly,

JOHN STERLING DEANS,
Chief Engineer.

On August 13, in reply to Mr. Deans, Mr. Cooper wrote as follows:

Dear Sir:—The information regarding chord splice 7 and 8-L, is so different from the dimension sketch sent by Mr. McLure, I can take no action on this matter till the exact facts are presented. Please have your resident engineer and Mr. McLure re-examine this joint and send the exact condition of this rib, as to the amount of the bends and relation of the bearing services to each other.

I don't see how one rib being bent only, as stated in your letter, there can be a complete and full bearing of these ribs. Neither can I understand how pulling the rib into line at the shop could bend it out of line.

I will write Mr. McLure to-day to have a further investigation of this joint and to report as promptly as possible. Yours very truly,

THEODORE COOPER.

And on the same day Mr. Cooper wrote to Mr. McLure:

New York, Aug. 13, 1907.

N. R. McLure, Esq., Inspector for erection, Quebec Bridge, New Liverpool, P. Q., Canada.

Dear Sir:—Mr. Deans writes me that only one rib at joint 7 and 8-L is bent and still that there is a full and complete bearing; that the bend was no doubt put in the chord in the shop before facing.

I have asked him to instruct his resident engineer to join with you in making an exact report, with dimensions of the conditions of this joint, with amount of bearing, and if it is a square bearing or askew.

In reference to the splicing of T-5 and T-50, mentioned in your letter of 10th, I do not care to interfere with the regular programme, as I have not followed the various actions of the loadings at different stages, without going into it carefully. I think there will be more compression at these points with more of the suspended span in place.

Please report promptly regarding joint 7 and 8-L with all the facts.

Yours truly,

THEODORE COOPER.

Mr. Deans wrote Mr. Cooper on August 14 as follows:

Dear Sir:—Chord splice 7 and 8-L. Your letter Aug. 13.

I will have a full and complete report made of this joint by Mr. McLure and Mr. Birks, and submit it to you earliest possible moment.

Yours truly,

JOHN STERLING DEANS,
Chief Engineer.

On August 14, Mr. Cooper received the following letter of the 12th from Mr. McLure:

Dear Sir:—I beg to acknowledge the receipt of your letter of Aug. 9 and have noted what you say regarding the method of repairing splice between chord 7 and 8 cantilever arm west truss. We will not do anything with this then until the matter has been arranged between yourself and Mr. Szlapka.

The reason I did not report at first as to how these chords got bent was because there were many different theories here as to the cause, no one of which I was at that time ready to accept. One thing I am reasonably sure of, and that is, that the bend has occurred since the chord has been under stress and was not present when the chords were placed. This being the case, the cause of the bend would seem to be the slight overrunning in length of the bent rib in either chord 7 or 8. Owing to the fact that these chords are faced on the rotary machine the four ribs at once this would at first seem to be out of the question, but it seems to me that after the first end of a chord has been faced in turning it with the crane, to bring the other end into position for facing, it might be possible for one rib to work slightly by the others longitudinally, without being noticed, and in spite of the latticing, and thus cause a slight difference in length. In fact, in taking the opening in the chord splices on the south anchor arm, it has often been noticed that a considerable variation existed between the openings of the different ribs at the same splice, which difference I was not able to account for except by the above theory—that during transportation, and in the handling before erection, some of the ribs have worked slightly in a longitudinal direction by each other. In the case in question, of course, this must have happened between the time of facing one end and the other. If this is correct, then it will be a pretty hard matter to draw this splice back into line with bolts, and our idea in suggesting that a diaphragm was to prevent this eccentricity from increasing, rather than to correct that already there.

As I had supposed, the strike in force for the last three days of last week, has been settled, and work has again resumed this morning. A meeting of the union was held Saturday night and enough of the discontented element had been lost so that when the matter was brought to a vote the majority were found to be in favor of returning to work under the original agreement. Those who were not in favor of returning to work, however, are now leaving so that our force is reduced greatly on both sides of the river.

Since writing the above I have discovered that splice between the chords

8 and 9 on west truss of south cantilever arm is in the same condition, exactly as that between 7 and 8, except that the bend is only 5/16-in., instead of ¾-in., at the bottom, and runs out so that on top this rib is in line as are the other three.

This is the same rib, and the bend is in the same direction as that reported for the other splice. When it is decided in what way to treat the splice between chords 7 and 8 we will repair that between chords 8 and 9 in a similar manner. Yours very truly,

N. R. M'LURE.

To this Mr. Cooper replied to Mr. McLure on August 15 as follows:

Dear Sir:—None of the explanations for the bent chord stand the test of logic.

I have evolved another theory, which is a possible, if not the probable one. These chords have been hit by those suspended beams used during the erection, while they were being put in place or taken down. Examine if you cannot find evidence of the blow and also make inquiries of the man in charge. Yours very truly,

THEODORE COOPER.

A further report was made by Mr. McLure to Mr. Cooper on August 16th:

Dear Sir:—Referring to your letter of 13th, regarding splice between 8-L and 7-L on south cantilever arm, you have not doubt by this time received my letter of the 12th inst., giving my theory of the cause of this bend. These conditions are as indicated in my report of Aug. 6. Mr. Birks, the resident engineer for the Phoenix Bridge Company, reported exactly the same thing, in somewhat different language to Phoenixville, but Mr. Deans had evidently taken a different meaning from his report than was intended. He evidently thinks that only one rib of one chord is bent, whereas it is the same rib at each chord, as indicated in the sketch I sent you. There is really nothing to add to the two letters I have already written regarding this bend, except to say that all the four ribs have full bearing on each other, as indicated also in the sketch of Aug. 6. In order to verify our first reports, Mr. Birks and I made a careful and more thorough measurement of this splice to-day, both top and bottom, and I am enclosing a blueprint of a sketch made as a result of these measurements. It indicates practically the same condition as described in my first letter, except that it is given more in detail.

As to the cause of this bend, regarding which I wrote you on Aug. 12, Mr. Deans seems to think that it was put in in the shops; but that is because he did not understand the condition existing. Aside from the fact that it would be hardly probable that these two ribs of different chord sections should be bent the same way—exactly the same amount in the shops—to dimensions ½-in. to ¾-in. less than called for, I am reasonably sure, as I said before, that this condition did not exist before the erection of these chords, as I have personally inspected every member yet erected in this bridge thus far, except the bottom chords of another arm, on the cars just before the erection, looking particularly for bends in ribs of compression members, and whenever discovered have taken measurements of the amounts and recorded them. If these ribs then had been this much out of line before erecting, it would be well nigh impossible to miss seeing them. Consequently, the only way the bend could have occurred, it seems to me, is that reported in my letter of Aug. 12.

I trust that these explanations, with the enclosed sketch, will make the matter entirely clear. Mr. Birks is sending same sketch to Phoenixville to-day. Very truly yours,

N. R. M'LURE.

Mr. Deans also received a copy of this sketch and wrote Mr. Cooper on August 20 as follows:

Dear Sir:—We have advice from your field that you received copy of sketch No. 28, giving further details in connection with cantilever chord splice 7-L and 8-L. You will notice that the two chords have a perfect bearing with each other at all ribs. Both chords having one bent rib and not one chord only as we first understood. Yours truly,

JOHN STERLING DEANS,
Chief Engineer.

To which Mr. Cooper replied on August 21 as follows to Mr. Deans:

Dear Sir:—I received copy of sketch of joint 7 and 8-L two days ago.

I wrote Mr. McLure last week telling him none of the theories as to how this bending occurred was logical. That my theory was a blow on this rib after the two sections were in contact, and that it probably was done in moving those suspended beams used in erecting. To examine carefully to see if he could find any evidence of this. He has not yet reported. He did report a similar bend in L-8 and 9 west truss in same rib, but of less amount.

I still believe this bend can be partly removed by use of long bolts with threads at each end—outer rib being stiffened to prevent its bending. If it can be pulled nearer straight, stays or bolts must be provided to hold it against future movement.

I cannot consent to let it go without further action as the rivets in the cover splices would not satisfy the requirements to my mind.

Yours very truly,

THEODORE COOPER.

This letter was acknowledged by Mr. Deans on August 23 in the following letter to Mr. Cooper:

Dear Sir:—"Joint 7-L and 8-L south cantilever arm."

Referring to your letter of Aug. 21, I notice you expect to hear again from Mr. McLure. As soon as you have this report kindly let us hear from you again, and oblige. Yours truly,

JOHN STERLING DEANS,
Chief Engineer.

On August 26 Mr. Cooper wrote the following letter to Mr. Deans:

Dear Sir:—Mr. McLure reports that he can find no evidence of the bent ribs having been hit and does not think they could have been struck. This only makes the mystery the deeper, for I do not see how otherwise the ribs could have been bent.

When convenient I would like to discuss with Mr. Szlapka the best means of getting these ribs into safe condition to do their proper work.

Yours very truly,

THEODORE COOPER.

This was acknowledged August 27 by Mr. Deans to Mr. Cooper:

Dear Sir:—Chord splice 7 and 8 cantilever arm south side.

Replying to your letter of Aug. 26, I will have Mr. Szlapka call to see you first opportunity to discuss this question. He will write you later the day he will be in New York. Yours truly,

JOHN STERLING DEANS,
Chief Engineer.

This was the last that transpired with regard to the bent ribs at joint 7-L and 8-L cantilever arm, and it is plainly indicated that no one except Mr. Cooper looked on this matter as serious or as indicating any constitutional weakness. It will be noted that the bends at 7 and 8 were reported on August 6, the bends at 8 and 9 discovered on August 12, and that both bends were in the west truss, that previously from time to time chords with ribs more or less wavy had been reported, and Mr. McLure gave it as his opinion that these bends were caused by stress since erection, because he was sure they were straight when erected, while Mr. Deans thought the bends were made in the shop.

While Mr. Deans after Mr. Szlapka's return gives certain information as to the bend in the 7 and 8 splices, Mr. Szlapka states that on his visit to the bridge he did not examine this splice, and further says that during none of his three visits to the bridge did he examine any chords. Mr. Kinloch states in his evidence that he did not notice the bends at the 7-L and 8-L joints when the bottom cover plate was first removed, and that he felt confident that these distortions took place after the removal of the cover plate.

It seems clear from the above that Mr. Cooper's statement that the delicacy of the joints was not sufficiently appreciated by the Phoenix Bridge Company is substantiated. Mr. Szlapka was on the ground and made no special examination in the matter, and Mr. Deans endeavored to throw the blame for the distortions entirely on the shop work. No evidence has been shown to us to prove that Mr. Deans had any grounds for this assertion, and his inspector, Mr. Morris, was in possession of information that indicated that there was no great probability that such an error could have escaped detection. On August 20, Mr. Kinloch discovered that chord 8-R of cantilever arm was bent, and afterwards found that 9-R and 10-R also showed distortion, he called Mr. Birks' attention to this condition, but neither of them considered it of importance. Mr. McLure was ill and did not see these bends until several days after they were found (August 23), but Mr. Yenser was made aware of them. On August 23 the joint at chords 5 and 6-R of cantilever arm was found to be off on one center rib ½ in. at bottom, the offset running to nothing at top. Mr. Kinloch visited chord 8-R daily for several days and imagined that the bend was becoming greater, all four ribs being bent, but not alike.

The bend in chord 9-L anchor arm was discovered about 9.30 a.m. August 27 to have greatly increased, it having been previously noted and being under observation. Owing to the fact that the 25th was a Sunday and that there was practically no work done on the 26th, it is doubtful whether this chord was examined between the 24th and the 27th. Mr. Kinloch, who made the discovery, in his evidence says:

Q.—Please relate the occurrences following your discovery of the bent chord on Aug. 27.

A.—Immediately after discovering the bend I brought the matter to the attention of Mr. Yenser and Mr. Birks, and with them re-examined both chord A 9-L and several other lower chord members. We did not know what to make of the matter and then went up to our office and arranged with Mr. McLure to have the deflections of the suspicious chords measured—this measurement, which was made by Birks, McLure and myself, showed the extent of the deflections; and their cause and their ultimate result immediately became a matter of very active discussion. Mr. Birks expressed himself definitely as being of opinion that there was no danger and endeavored to persuade me that the bend had always been in the chord. Mr. Yenser and I were uneasy and considered the matter serious, and finally suggested that Mr. McLure and Birks should go to New York and Phoenixville for advice. It was considered that the matter could not be satisfactorily explained by telegraph or telephone, and none of us expected immediate disaster. Mr. Birks and Mr. McLure did not welcome our suggestion, saying that they would only be laughed at on arrival, and it was finally agreed to refer the matter of sending to headquarters to Mr. Hoare, who decided in favor of our suggestion. Mr. Hoare visited the bridge on the Wednesday and spent most of the day there. He appeared very anxious that I should abandon my position of being positively convinced that the bend had occurred since the erection of the cantilever arm was completed, and argued both this and some possible method of strengthening the chord by bracing, several times with me. I was somewhat excited and much annoyed at the unwillingness of all the engineers to accept my statement of facts, and on both Wednesday and Thursday avoided further discussion of the matter as much as possible. It was understood that Mr. McLure would immediately wire me if Mr. Cooper took a serious view of the situation, but this he failed to do. Mr. Birks, however, told me on the morning of the 29th that he had been advised by 'phone from Phoenixville that they had a record which showed that the bends had been in the chord before it was shipped from Phoenixville, and that he had just advised Mr. Hoare by telephone at the request of Mr. Deans to that effect.

As soon as the measurements above referred to were made, it was recognized by Mr. Yenser and the inspectors that they were

face to face with a crisis. Mr. Yenser announced his intention of stopping erection until he had referred the matter to Phoenixville. The measurements were plotted and were reported by mail to Mr. Cooper and to Phoenixville, these reports being delivered on the morning of the 29th. Owing apparently to anxiety already existing among the workmen it was not considered wise to use either telegraph or telephone. As suggested by Mr. Kinloch, Mr. McLure reported the matter fully to Mr. Hoare on the evening of the 27th, the delay of about 12 hours being accounted for by the making and plotting of the measurements and the necessity of using a personal messenger as it was not wished to report particulars over the telephone. It is clear that Mr. Yenser, Mr. Kinloch and Mr. McLure were very much alarmed, but Mr. Birks could not be convinced that the bends had recently taken place. He knew better than anyone else on the work the care with which the calculations and designs had been made; he was familiar with the experience and abilities of the designers, and could calculate that the stresses were then far below the expected maximum.

To engineers the force of such reasoning is very great and we do not consider that the confidence Mr. Birks placed in his superiors was in any way unusual or unreasonable. There was no misunderstanding, however, on his part; he realized that if the bends had not been in the chord before it was erected, the bridge was doomed, and although Mr. McLure had evidence that the bends had increased more than 1 in. in the course of a week, although Mr. Kinloch was positive that the bends had very recently greatly increased, and although Mr. Clark stubbornly maintained that the chord was absolutely straight when it left Chaudiere yard, Mr. Birks still strove to convince himself that they must have been mistaken. Mr. Hoare evidently concluded that the matter was too serious for him to settle by any offhand decision, and approved Mr. McLure's mission to New York, wisely requiring that he should get all possible facts before leaving, so that Mr. Cooper need not wait for further information on which to base a decision.

The text of Mr. McLure's report of August 27 is as follows:

New Liverpool, P. Q., Aug. 27, 1907.

Mr. Theodore Cooper, Consulting Engineer, 45 Broadway, New York.

Dear Sir:—I enclose sketches showing condition of bottom chord sections "606—9 L" of south anchor arm and "621—9 R and 8 R" of south cantilever arm, as found from measurements made to-day by the Phoenix Bridge Company's Assistant Engineer and myself, by stretching a line from batten plate to batten plate as indicated on the sketches and measuring from this line held taut, to each rib, top and bottom. It was noticed this morning that these chords were bent in this manner, as it is very evident to one walking over them, and as it looked like a serious matter, we measured them.

Although a number of the chords originally had ribs more or less wavy, as I have reported to you from time to time, it is only very recently that these have been in this condition, and their present shape is undoubtedly due to the stress they are now receiving. Only a little over a week ago, I measured one rib of the 9—L chord of anchor arm here shown, and it was only ¾ in. out of line. Now it is 2¼ in.

In the sketches the red indicates straight lines and black ones the ribs of chords. A top and bottom view is shown in each case. You will note that chords 606—9 L and 621—9 R have all ribs bent in same direction, while 621—8 R has its ribs bent in reverse curves. These bends had become so apparent by to-day that the gangs riveting at these points noticed them, and called Mr. Kinloch's attention to them.

This matter is being reported in this mail, with sketches from the same measurements, to the Phoenixville office, and the erection will not proceed until we hear from you and from Phoenixville. Yours very truly,

N. R. M'LURE.

Wednesday, August 28, was a day of waiting and uncertainty. Mr. Yenser had changed his mind during the night and in the morning continued erection. The men were uneasy and alarmed and the officials were anxiously awaiting instructions from Phoenixville or New York. Mr. Yenser's decision to continue work was laid before Mr. Hoare, upon whom, as Chief Engineer, the final responsibility for every step taken rested, who decided that Mr. Yenser had acted wisely. Mr. Hoare makes this clear in the following letters to Mr. Cooper:

Letterhead (The Quebec Bridge & Railway Co.).

Quebec, Aug. 28, 1907.

Theodore Cooper, Esq., 45 Broadway, New York City.

Dear Sir:—I wired you to-day as under:

"Have sent Mr. McLure to see you early to-morrow to explain letter mailed yesterday about anchor arm chords."

Also the following message to the Phoenix Bridge Co.: "Mr. McLure will call to-morrow to explain Birks' letter *re* anchor arm chords. Will see Mr. Cooper first."

Regarding this matter I thought it best for McLure to go at once to be able to explain matters and answer questions. He did not have much time for extended investigation before leaving.

I have been at the bridge all day trying to get some evidence in connection with the bending of the ribs in this chord. Mr. Kinloch noticed it for the first time yesterday and all inspectors declare that no such pronounced distortion existed a few weeks ago. Mr. McLure made measurements yesterday afternoon and brought them to my house late last night, and stated that the erection foreman hastily concluded that he would not continue erecting to-day, which alarmed me at the time. Upon arriving at the work this morning he thought better of it and decided to go ahead, at the same time asking me if it would be all right. After ascertaining that the effects from moving the traveler ahead and proceeding with the next panel would be so insignificant I requested him to continue, as the moral effect of holding up the work would be very bad on all concerned and might also stop the work for this season on account of losing the men. From further investigation during the day I cannot help concluding that the metal received some injury before it was erected, as the corresponding chord in the same panel and stressed the same is in good condition. These panels are being stressed to-day, approximately, about $^{7}/_{10}$ of their maximum, and it is difficult to believe that this is the entire cause of the distortion. Now and again a rib in certain members is found to be a trifle longer than another, which, when compressed, might cause a trifling kink in it. There are a few examples of this. The chord in question, when being lifted to the cars in the storage yard broke loose from the grips, one end of which fell a distance of 6 ft. on to timber sills; the other end fell a distance of 2 ft. on to a block of eyebars. In falling it fell over on its side, breaking one of its angles on the north end splice and twisting some of the lacing bars, all of which were renewed. After this the inspectors reported the ribs perfectly straight. On account of this chord falling on to two rigid higher points at ends, with no support in the middle but soft material, the conclusion would be that the deflection would be downward, as a matter of fact the evidence shows that it was in the opposite direction. Since Mr. McLure left, Mr. Birks has made careful examination of the chord and states that the actual bending commences at the south splices and was not confined entirely to the length between the bottom plates, where the lacing angles are used. As the foreman and inspectors declare that these defects were not noticeable until recently, perhaps the stress in this chord has made previous defects more pronounced. I thought I would give you the above story from further investigation by to-night's mail to help you to come to some conclusion.

Yours truly,

E. A. HOARE.

Letterhead (The Quebec Bridge & Railway Co.).

Quebec, Aug. 22, 1907.

Theodore Cooper, Esq.

Dear Sir:—Mr. Birks has just called me up on the telephone from the bridge and states that he has received a message from Phoenixville stating that they have positive evidence that the chord was not straight before it left the shops. This possibly clears up the mystery why the deflection was in the opposite direction to what it should have been, due to its fall in the storage yard. Mr. Birks has wired that information to Mr. McLure at your office. Mr. Birks further stated that he is positive that the chord ribs were more or less out of line when the splices at the south end was riveted up in the bridge. Yours truly,

E. A. HOARE.

Letterhead (The Quebec Bridge & Railway Co.).

Quebec, Sept. 2, 1907.

Theodore Cooper, Esq.

Dear Sir:—I thank you for replies to all our messages. I am sorry that you are not well and of course, this appalling disaster has made you feel a thousand times worse.

Mr. Berger will answer our purpose very well for the present. The investigating commission may find it necessary later to interview you in New York, due notice of which will be given you.

I wish to correct a misstatement in my letter to you of the 28th of August, which was written late and very hastily to confirm telegram and conversation with Mr. Birks about the chord under discussion. The statement in my letter as follows:

"Mr. McLure made measurements yesterday afternoon and brought them to my house late last night and stated that the erection foreman hastily concluded that he would not continue erecting to-day, which alarmed me at the time. Upon arriving at the work this morning he thought better of it and decided to go ahead, at the same time asking me if it would be all right. After ascertaining that the effects from moving the traveler ahead and proceeding with the next panel would be so insignificant I requested him to continue, as the moral effects of holding up the work would be very bad on all concerned and might stop the work for this season on account of losing the men."

is to some extent a misstatement of facts and not clearly stated, due to too much haste, and which I wish now to correct as under.

"Upon arriving at the work that morning the foreman told me that he had considered it during the night and had already removed the traveler forward, asking myself, Mr. McLure and Mr. Birks if we thought that what he had done would do any harm. We all thought that it would not, as they stated it would only add 50 lbs. to the square inch to the chord in question. We all thought at the time that to discontinue the work would entirely stop the work for this season as the men would not wait and would go elsewhere to prepare for the winter."

As stated in my last letter, strictly speaking, I did not request the foreman to continue the work, as he had already done so; at the same time we thought there was no immediate danger in adding so small a load. This letter more clearly states the conversation between us, and I am sorry that I have misstated in my hurry one or two points which would be more or less confusing. Yours truly,

E. A. HOARE.

It was clear that on that day the greatest bridge in the world was being built without there being a single man within reach who, by experience, knowledge and ability was competent to deal with the crisis. Mr. Yenser was an able superintendent, but he was in no way qualified to deal with the question that had arisen. Mr. Birks, well trained and clear headed, lacked the experience that teaches a man to properly value facts and conditions, and Mr. Hoare, conscious that he was not qualified to give judgment, simply assented to the courses of actions that had been determined on by Messrs. Yenser and Kinloch and made no endeavor to make a personal examination of the suspected chords.

Some measurements were made to test the stability of the main pier, but no one seems to have thought of testing the span for alinement or levels, and, above all, to measure the chords again to see if they showed any increase of deflection. Mr. Moore discussed some means of bracing the chords, but decided to postpone action

until Mr. Cooper was heard from. At Mr. Hoare's request Mr. Birks inspected the chord A 9-L and the A-L 8 9 joint carefully, and his observations tended to reassure both Mr. Hoare and himself, as he thought that he found evidence of original crookedness in the chord.

His report to Phoenixville, which was received on August 30, reads as follows:

New Liverpool, P. Q., Aug. 28, 1907.

The Phoenix Bridge Company, Phoenixville, Pa.

Dear Sirs:—I have made a further investigation of chord 9 A, and beg to report following additional data: The bend in the chord starts at the faced splice at the shore end and not at the edge of the splice batten. It appears from this that at least a large portion of the bend was in the chord when the top and bottom splice battens were riveted early in June. This and the fact that the lacing angles are not disturbed leads me to believe that the ribs were bent before erection, in spite of the fact that Mr. Clark and Mr. Kinloch think all ribs were straight when the chord was repaired. From the evidence, so far, I do not think we are justified in assuming it to be a fact that the ribs of any of the chords have buckled since erection, and Mr. Yender has come to the same conclusion. Yours truly,

A. H. BIRKS.

After he had made his examination, Mr. Birks called Mr. Kinloch and waited at track level, while Mr. Kinloch went down to the chord and checked Mr. Birks' observations. After careful discussion with Mr. Kinloch of what was then done we are forced to conclude that the sketch in Mr. Birks' letter shows only his personal idea of the shape and extent of the existing distortion and cannot be considered as furnishing data on which to base engineering conclusions, as no actual measurements were taken.

On August 29 Mr. Birks' report of the 27th was received at Phoenixville and was immediately discussed by Messrs. Deans and Szlapka and Milliken. It was finally decided that it was safe for the work to proceed and a telephone conversation took place between Messrs. Milliken and Yenser and another between Messrs. Deans and Birks. Mr. Szlapka had made some calculations and Mr. Birks reported his observations of August 28. Messrs. Yenser and Birks were assured that the office approved their action in continuing work of erection and Mr. Birks was told to tell Mr. Hoare that the bends had been in the chords before they left Phoenixville. This Mr. Birks did.

Mr. Deans also telegraphed Mr. Hoare as follows:

Phoenixville, Pa., Aug. 29, 1907.

E. A. Hoare, Esq., Chief Engineer, Quebec Bridge Co., Quebec, Canada:

McLure has not reported here; the chords are in exact condition they left Phoenixville in and now have much less than maximum load.

Mr. Hoare had telegraphed to both Mr. Cooper and Deans on August 28 advising them of Mr. McLure's mission. Mr. Deans has since explained that his telegram did not refer to the chords measured on the 27th, but after considering the circumstances, we are entirely satisfied that Mr. Hoare was justified in thinking that it did, and in so doing he was confirmed by Mr. Birks' telephone message previously received.

From the time these assurances were received, anxiety at the bridge practically ceased, and there is no evidence that any further measurements were made to determine the movements of the suspected chords. As Mr. Hoare expressed it: "I felt quite comfortable that day about it. I knew it could not be long before the matter would be taken up."

Shortly after 11 a.m. on August 29, Mr. Cooper reached his office and found Mr. McLure there. After a brief discussion, Mr. Cooper wired to Phoenixville as follows:

New York, Aug. 27, 1907, 12:16 p. m.

Phoenix Bridge Co., Phoenixville, Pa.:

Add no more load to bridge till after due consideration of facts. McLure will be over at five o'clock.

This message was received at Phoenixville at 1:15 p.m. Mr. Cooper nas explained in his evidence that he was not aware at the time that erection was proceeding. Mr. McLure having advised him to the contrary, and that he telegraphed to Phoenixville instead of to Quebec because he thought action would be more promptly secured by so doing.

Mr. McLure had promised to wire Mr. Cooper's decision to Mr. Kinloch immediately, but he did not do so.

Mr. Deans reached his office about 3 p.m. and found Mr. Cooper's telegram there. He arranged for Mr. Szlapka and Mr. Milliken to be on hand to meet Mr. McLure, but otherwise took no action. After Mr. McLure arrived there was a brief discussion during which Mr. McLure mentioned that he had received a wire from Mr. Birks giving him the result of that gentleman's observations on August 28. It was decided to postpone action until the morning and to await the arrival of Mr. Birks' letter of August 28. This decision was made almost at the minute that the bridge fell.

As a conclusion reached from the evidence and from our own studies and tests, we are satisfied that the bridge fell because the latticing of the lower chords near the main pier was too weak to carry the stresses to which it was subjected, but we also believe that the amount of those lattice stresses is determined by the deviation of the lines of center pressure, from the axes of the chords, and this deviation is largely affected by the conditions at the ends of the chords. We must, therefore, conclude that although the lower chords 9-L and 9-R anchor arm, which, in our judgment, were the first to fall, failed from weakness of latticing, the stresses that caused the failure were to some extent due to the weak end details of the chords, and to the looseness, or absence of the splice plates, arising partly from the necessities of the method of erection adopted, and partly from a failure to appreciate the delicacy of the joints, and the care with which they should be handled and watched during erection. We conclude from our tests that owing to the weakness of the latticing, the chords were dangerously weak in the body for the duty they would be called upon to do. We have no evidence to show that they would have actually failed under working conditions had they been axially loaded and not subject to transverse stresses arising from weak end details and loose connections. We recognize that axial loading is an ideal condition that cannot be practically attained, but we do not consider that sufficient effort was in this case made to secure a reasonable approach to this condition. The Phoenix Bridge Company showed indifferent engineering ability in the design of the joints and did not recognize the great care with which these should be treated in the field.

We consider that Mr. Deans was lacking in judgment and sense of responsibility when he approved of the action of Mr. Yenser in continuing erection, and when he told Mr. Birks and Mr. Hoare that the condition of the chords had not changed since they left Phoenixville.

No evidence has been produced before the Commission in proof of the correctness of this statement about the chords, and Mr. Szlapka's calculations, as stated in the following letter, showed that the rivets were even then loaded to their maximum specified stress of 18,000 lbs. per sq. in.

Montreal, Jan. 24, 1908.

Phoenix Bridge Company, Phoenixville, Pa.

Gentlemen:—Will you please file with the commission a copy of the calculations made by Mr. Szlapka on Aug. 29, 1907, and which are referred to on pages 967 and 968 of the evidence.

As we are nearing the completion of our report, we would esteem it a favor if you would have this information sent to us immediately.

It is possible that you may not have an exact copy of these calculations, but no doubt they can be duplicated, and Mr. Szlapka's certificate to this effect will be sufficient. Truly yours,

HENRY HOLGATE.

Phoenixville, Pa., Jan. 31, 1908.

Henry Holgate, Esq., Chairman Royal Commission, Montreal, Canada.

Dear Sir:—Replying to your letter of Jan. 24, I enclose herewith letter from Mr. Szlapka of this date giving calculations similar to that made on Aug. 29, regarding chord 9-L south cantilever arm. Yours truly,

JNO. STERLING DEANS,
Chief Engineer.

Phoenixville, Pa., Jan. 31, 1908.

John Sterling Deans, Esq., Chief Engineer the Phoenix Bridge Co., Phoenixville, Pa.

Dear Sir:—Referring to Mr. Holgate's letter of Jan. 24, addressed to the Phoenix Bridge Company, I beg to give you below the calculations similar to the one made on Aug. 29, 1907, referring to chord 9-L south anchor arm.

Taking 1½ in. as the average reported curvature of chord 9-L we have:

$$\frac{W\ L}{4} \times 12 = 780^\circ \times 18{,}000 \times 21{,}060{,}000 \text{ in.-lbs.} \qquad \frac{W}{2} = 61{,}600 \text{ lbs.}$$

$$\text{Stress in each lattice: } S = \frac{61{,}600 \times 1.}{4} 4 = 21{,}600 \text{ lbs.}$$

Yours truly,

THE PHOENIX BRIDGE COMPANY,
PER P. L. SZLAPKA.

The theory underlying these calculations is very questionable, but it was adopted in the design of the bridge, and we cannot understand why its warning was so entirely disregarded in the face of the consequences that might result.

With reference to Mr. Cooper's telegram, Mr. Deans knew that he was in possession of later information from the bridge than had reached Mr. Cooper and therefore decided to wait for Mr. McLure and afterwards for the arrival of Mr. Birks' letter of August 28 before taking action. The whole incident points out the need of a competent engineer in responsible charge at the site.

Mr. Hoare was the only senior engineer who was able to reach the structure between August 27 and August 29. He was fully advised of the facts, yet did not order Mr. Yenser to discontinue erection which he had power to do. We consider that he was in a much better position than any other responsible officer to fully realize events that had occurred, and his failure to take action must be attributed to indecision and to a habit of relying on Mr. Cooper for instructions.

We are satisfied that no one connected with the work was expecting immediate disaster, and we believe that in the case of Mr. Cooper his opinion was justified. He understood that erection was not proceeding, and without additional load the bridge might have held out for days. Our tests have satisfied us that no temporary bracing such as that proposed by Mr. Cooper could have long arrested the disaster; struts might have kept the chords from bending, but failure from buckling and rivet shear would soon have occurred.

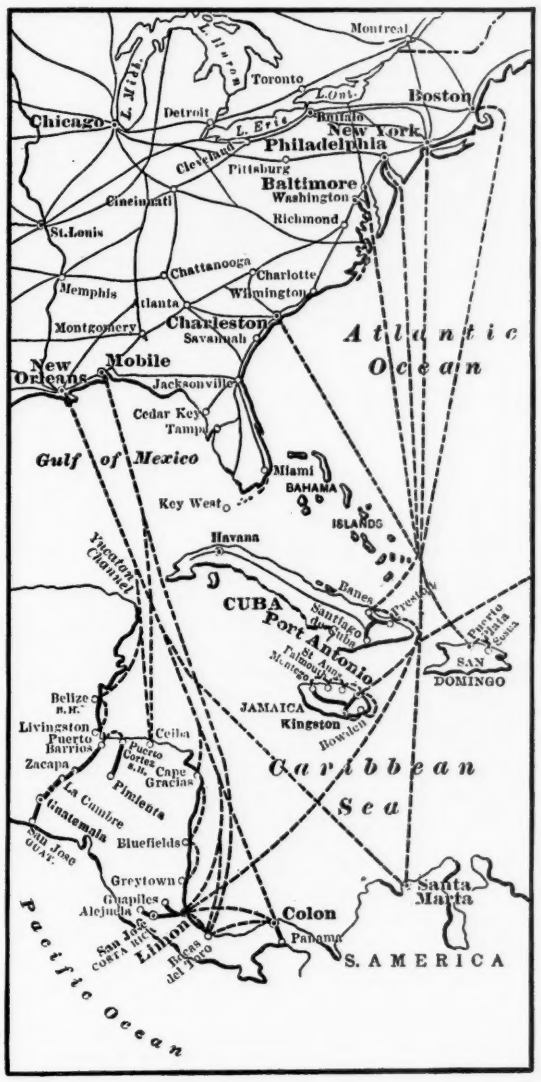
The Ocean Carrier.

BY J. RUSSELL SMITH, PH.D.

XI.

The Renaissance of the Merchant Carrier: The Private Steamship Line.

The nineteenth century has witnessed the evolution of the common carrier by sea. At the beginning of the period the merchant carrying his own goods was the conspicuous figure. But, by one of the strange repetitions of history, his disappearance was quickly followed by reappearance. The twentieth century opens with private carriers, operating on such a scale that they are able to run lines of steamships as links in huge productive and mercantile enterprises. This change is due to the magnitude of the modern corporations, which outrank the individual as a regiment outranks a policeman.



Map of United Fruit Lines.

Present operations in coal, iron, petroleum, asphalt, fruit and other industries are prosecuted on a scale unprecedented in size and made possible only by the modern corporation, in which property and resources sufficient for a medieval kingdom are bound together by telegraph and telephone by which a more than military organization can control an army of men laboring towards a common result. Like a state or a regiment, the corporation has an organization and a continuous existence that depends upon no man's life, and it can, by this scope and continuity of action, attain a scale enabling it to incorporate and use a steamship line as a part of a single business. This has occurred in both agriculture and manufacture, in the marketing of products, and the assembling of raw materials.

There are several reasons for this development of the line as an adjunct to an industry:

First.—The freight for shipment from the ports of a certain region may be only of the coarse and bulky character that goes in full cargoes. There is then small demand for the services of a common carrier to furnish line service. It is chiefly in such regions that the industrial steamship line has arisen.

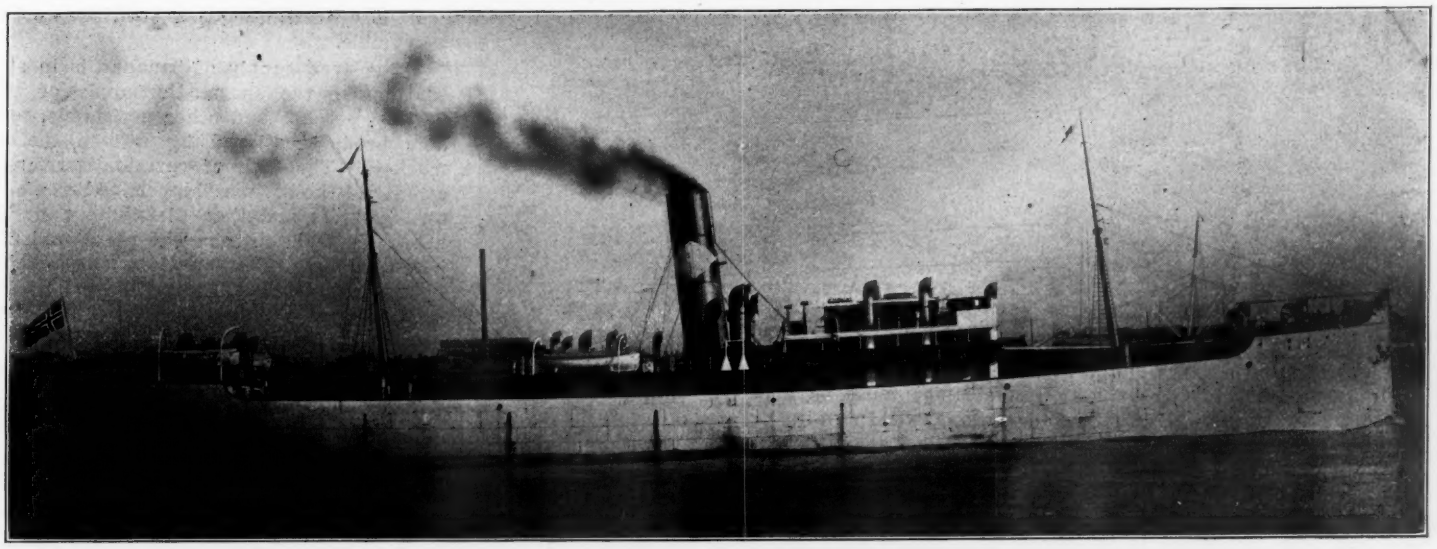
Second.—With private-carrier traffic of the character just referred to, it is natural for the large operations of modern business to demand regularity of movement. Hence a line arises within the service that naturally belongs to tramps.

Third.—Special service may be required with specially designed vessels to supply it.

Fourth.—The ordinary arguments in favor of consolidated enterprises—elimination of intermediate profits and reduced cost of supervision per unit of output incident to the enlargement of the business are potent in water transportation.

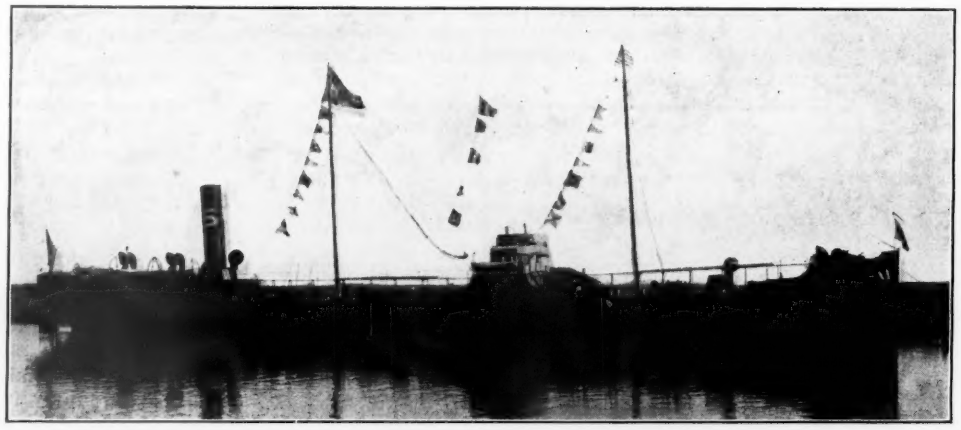
Probably the best examples of the industrial steamship lines are to be found in the oil industry and in the American banana industry. Well over 100 steamers are engaged in carrying bananas from the West Indian and Caribbean region to the United States and Europe. Over nine-tenths of these vessels are operated or controlled by a single company. The evolution of the business and its transportation organizations have been rapid. In the beginning bananas were occasionally sent to this country on consignment, a group of growers sometimes combining to send a small schooner, leaving the sale to some American commission merchant. This method is the one followed by the distant farmer who sends his produce to a large city market, but in the banana trade the practice did not survive. The usual method, even in the early days of the trade, was for the importer to send or take his ship to purchase the fruit at export points and bring it to our ports for sale on his own account. This has led to rapid changes in the business because of its especial need for organization and because the banana trade, owing to the perishable nature of the fruit, requires a faster ship than can commonly be found for hire. Ship owners will gladly build such boats if the banana merchant will promise to hire them all the time or for long periods; otherwise the ship might be compelled to take employment for which she was not well suited. The result is that the banana merchant must hire his ship for a long period, if at all.

The banana importer enters the business with heavy stakes and it is a business in which competition is particularly destructive. There is no middle ground upon which competition can exist. A steamer holds a great many bananas, and as they are a perishable commodity, sometimes sold at auction in the process of dis-



Steamship Ellis; United Fruit Co.—Designed Especially for the Banana Trade.

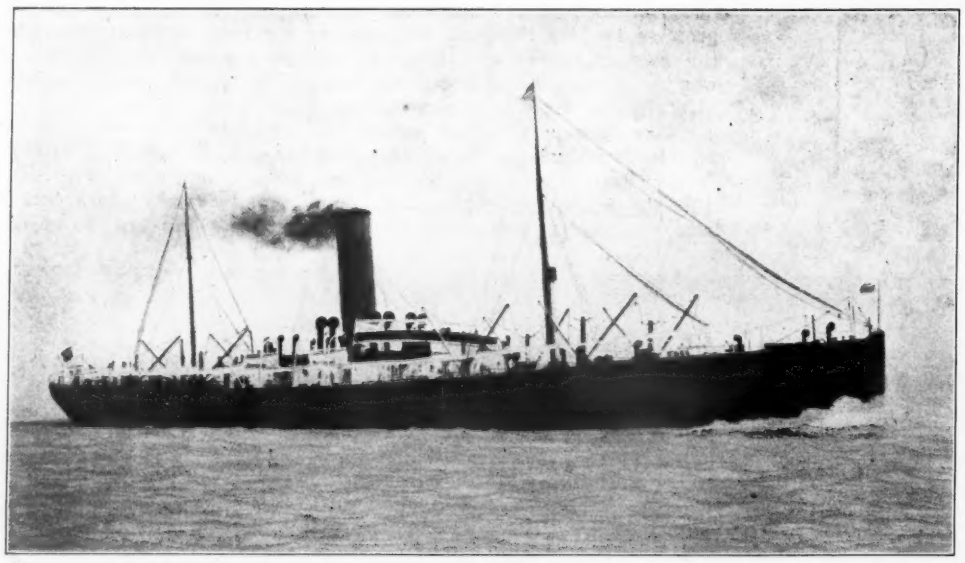
tribution, two steamers arriving at one port at about the same time may easily so overstock the market that there would be low prices and loss for both parties. It is therefore necessary for each company to know what the others are doing and keep out of the others' way or make conditions of mutual loss. Agreement is hard to maintain for some firm must exercise the whip hand, a position usually not to be accorded without competitions and wars. In the tropical fruit business these fights have come often and have usually been fights to a finish or to consolidation, so that by 1899 the chief survivor, the United Fruit Co., handled 98 per cent. of the American banana traffic, and with its hundred steamers it now scours the West Indian and Caribbean coasts, runs lines to Boston, New York, Philadelphia, Baltimore, New Orleans, Mobile and Bristol, England, and occasionally sends steamers to other ports in both England and America. At the present time this company's monopoly is not so complete as in 1899, but the independent companies do so small a business that they are not worth the cost of the general price reduction that would result from attempts to drive them out. A small company running one steamer to Philadelphia, for example, could not be forced out by competition unless the large company reduced the price on eight cargoes in that and other ports easily reached by rail. The independent knows that he dare not grow, or he would be big enough to be dealt with and put out of business. He has seen others die the death through prosperity in just that manner.



Captain A. F. Lucas; Standard Oil Coastwise Towing Service.

These vessels of the banana fleet do not usually belong to the fruit company. There is a drawback to the full working out of the process of consolidation at this point. Why does it not pay the fruit companies to stop paying profits to ship owners? Some of the earlier companies tried it, but it is being given up. The fruit is marketed in the United States and the companies are American companies, but owing to the cost of building and operating American ships they cannot afford to use American ships, and they must be operated under foreign flags and through foreign companies. This, combined with the large capital involved, has served to limit the fruit companies to carrying on most of their traffic in foreign steamers. It is, however, currently reported that there is some American money in these steamers. They are built on the specifications of the user, who often charters them for four-year terms before they are built, and some vessels have been taken for ten-year periods. These long charters show the real solidarity of the enterprise.

This process of consolidation is complete so far as water transportation is concerned, but it is only the beginning of the fruit company's enterprise. When a fruit company owns or is financially responsible for a steamer, that steamer must be kept employed as constantly as the banana seasons will permit. If she goes for bananas and cannot get them, there is loss on the steamer and loss of profits on the bananas that are not secured. As a consequence, the fruit business, which began as a mercantile operation and was compelled to include a carrier to have something to sell, has been compelled to become a producer to have something for the steamers to carry. Private producers on the hot, turbulent and sparsely peopled shores of the Caribbean could not be induced to produce a regular and sufficient supply of bananas and other fruits, and in self defense the underlying companies of the United Fruit Company long ago started plantations and orchards. The present company produces a large part of the fruit that it carries and sells. It is stated by their representatives that the cost to them of producing their own fruits is as great as that of the purchased fruit, but the quality is better and the supply more regular. The process has even gone farther* for the fruit company has organized subsidiary companies that build and lease railroads to carry the fruit from the plantations to the port of original shipment.†



Narragansett; Anglo-American Oil Company.

Once the steamer service of the United Fruit Company was organized, it was inevitable that this regular service should devote some room to other freight and to passengers, particularly as the other freight is almost exclusively return freight which can be put into an otherwise empty ship as she goes out for another cargo. The managers of the fruit company are also cognizant of the fact that the passenger traffic is profitable and that the fruit steamer is speedy and well suited for it. The addition of a limited number of state rooms does not seriously interfere with the fruit carrying capacity, so the fruit steamer has become a common carrier to a limited extent, for both freight and passenger, but this, like the company's ownership of Jamaica hotels for the entertaining of the tourists, is purely incidental to the main business which is the marketing of its own fruit. When the passenger business sprung up, the fruit company merely completed this circle also by providing hotels of the elegance and comfort necessary to satisfy the tourists attracted by their ships.

The formation of the United Fruit Company has in nearly all its steps been the result of economic causes and has resulted in the great enlargement of the industry. If some Czar should sell separately at public auction every single piece of property owned by the United Fruit Company and common carriers should attempt to carry the fruit, it would not be three years until some central power guided its distribution. It is but a step to the guidance of the ships themselves. If conditions demand the sending of one cargo to a port not regularly served, the ship, under central control, can be sent. If this business depended upon a line or lines of common carriers such a shifting would be impossible.

The even supply of bananas is in strong contrast to the spasmodic supply of strawberries, peaches and other perishable, seasonable produce shipped by rail to the same markets. The lack of common carriers has compelled the banana shippers to become their own carriers and then distribute their product by central control. The peach and strawberry business is larger when it comes, but it is not organically advanced beyond the stage of the banana business in its first beginnings. Each shipper sends, as suits his fancy, to commission men here and there. Markets are alternately glutted and starved, the demand is half met. The California orange growers have, by voluntary association, learned to control the distribution of their product, and in a few years probably other important industries will similarly organize and distribute their prod-

*President's address, 1905, meeting Royal Mail Steam Packet Co.

†It is easy to see here the possible basis for the bitter complaints that arise from the independent banana planters who declare that they have been forced out of the business. A returning traveler tersely puts it "The United Fruit Company owns Costa Rica." In this country the fruit company has some of its most extensive land operations.

uct as the exigencies of ocean transportation have compelled the banana shippers to do.

The marketing of asphalt, lumber, coal and petroleum is less exacting than fruit, in that these commodities are not perishable or easy of injury. There is consequently no imperative need of prompt despatch and the commodities may be carried in ships not especially constructed for one commodity. In the case of oil, however, tank steamers specially designed to carry kerosene or naphtha or crude petroleum in bulk show very great economies over other methods of shipment. The table appended indicates that the Standard Oil Company owns or controls nearly a third of the total tank steamer tonnage.

The first carrying of oil in bulk seems to have been in the Caspian sea in 1873. In the same year two vessels were built for the Philadelphia-Antwerp service and equipped for carrying bulk oil as a part of their cargo.* Oil and passengers, however, will not mix, owing to the regulations for the protection of the passengers, and as these steamers of the Red Star Line were in a very profitable place for passenger traffic, their oil tanks were unused. The use of tank steamers requires a corresponding large scale shore equipment of pipes and pumps and tanks that can only be provided by distributors on the largest scale. The carriage of bulk oil, therefore, is not a simple question of ships, shipping and ship management. In many parts of the world where there is large oil traffic there is no equipment for the accommodation of tank vessel cargoes. Consequently it was not until 1888 that vessels of this character were used on the Atlantic. Since that date, the extension of their use has been rapid. The larger ports of the great consuming countries of western Europe have the necessary receiving equipment and the pipe lines from the Ohio valley to the Atlantic coast ports, from the Caspian field to the Black Sea ports, and latterly from Texas and adjacent fields to the Gulf of Mexico, give wide sources for the supply of the cargo. The same method of distribution prevails east of Suez, where the chief supplies are in Burma, the Dutch East Indies, and to a lesser extent in Japan. Some firms† of tank carriers make a practice of supplying large users throughout the world and avoid paying Suez tolls by using Texas oil for points west of Suez and East Indian oil for stations to the east of the high tolled canal.

Tank steamers are used also in the American coasting trade, Texas crude oil being carried to the refineries on the Atlantic coast and the refined oil thence to Europe.

Recently the economy of this specialized transportation has gone one step farther than the tank steamer. It is the tank barge which the tank steamer tows. For several years prior to 1905 the Texas product had gone to Atlantic refineries in Standard Oil Company's steel barges. In that year the barges were first sent to Europe. This, however, was not the oceanic barge record, as a year before a barge had been towed by a tanker from New York to San Francisco, 13,090 miles, in 72 days.‡

Of late years these tank steamers have almost superseded the older form of oil traffic by which barrels were carried in any available vessel of ordinary type. Some of the tankers are owned and operated by European refining companies. In the old-fashioned way, 12,000 barrels were considered an enormous cargo, but the efficiency of special construction and the private industrial line is demonstrated by the 30,000-barrel cargoes of the new tank steamers.

The growth of the bulk oil traffic is indicated by the tonnage of the fleets engaged in that traffic. According to the Bureau of Corporations, this tonnage is as follows:

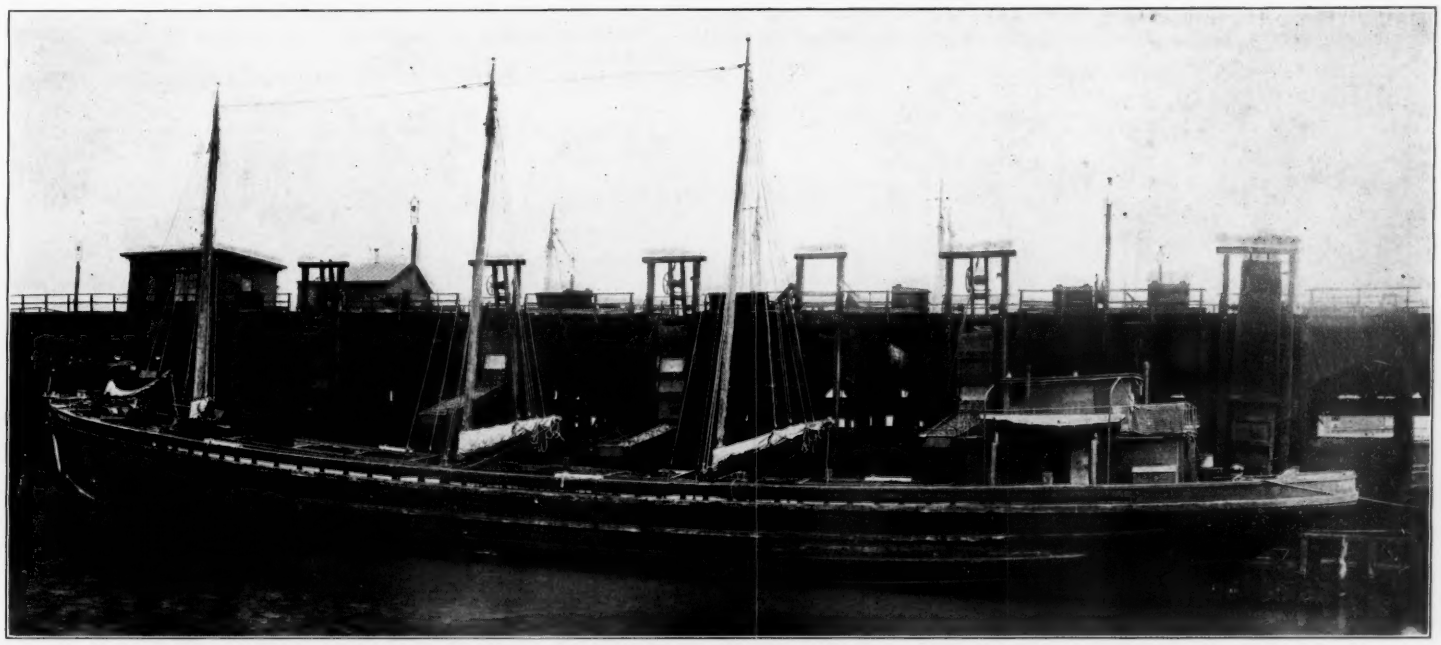
Companies.	Vessels.	Gross tons.
Standard Oil Co.	61	204,506
Standard Oil Co.	18*	11,367
Independent American	21	58,847
Independent American	8*	11,367
Russian companies	30	96,559
Dutch East Indian traders	41	125,161
Burmese and Japanese traders	6	12,810
English tramp steamships	18	55,831
English tramp sailing vessels	4*	8,209
French companies	2	2,525
Unclassified	9	12,707
Unclassified	4*	4,224
Total steam	188	568,946
Total sailing vessels(*)	34	51,866
Grand total	222	620,812

*Sailing vessels.

The enormous tonnage of this fleet of specialized vessels of peculiar type, for carrying one commodity only and belonging to a few owners, and nearly all of them merchant carriers, shows how in this age of common carriers the present merchant carrier, inconspicuous in his ocean work, nevertheless outranks by far his conspicuous prototype of a century ago in the actual amount of transporting that he does.

Nor does the above list of bulk vessels tell the whole story for petroleum. Many ordinary vessels are also used by the oil companies. The Oriental countries are heavy importers of American refined oil, and their markets, devoid of tank equipment, require it in small tin cans called cases. The transportation of this refined case oil has long employed a large amount of shipping, and the greater part of it has gone in full cargoes in sailing vessels. Oil alone comprises a high percentage of the value of American exports to China and much more than one-half of the total tonnage of the traffic. The Standard Oil Company for many years chartered other people's ships for this work, but some years ago it changed this policy and became sailing vessel owners for the better marketing of their own case oil product. The oil company does not own enough vessels to do all the ocean work, and some are still chartered, but all are operated under one management, so that the oil company's vessels now sail from Philadelphia and New York for the ports of East Asia, and one ownership carries the oil from the well in the Ohio valley to the Mongolian merchant in Shanghai or Yokohama. Inasmuch as the oil company had nothing for these sailing vessels to bring back, they have frequently aided the exchequer of the company by bringing back, from Calcutta, Manila and other ports, any available cargo that might be obtained.

The asphalt industry in America is one with a multitude of companies, but beneath them is a simplicity of interests that sifts down to two rival concerns. The raw asphalt comes almost exclusively from the island of Trinidad and the northern shore of Venezuela. It is consumed in all of the larger American cities and many of the smaller ones, and also in Europe, South America and elsewhere. The companies are international in their field of opera-



Coal Barge; Philadelphia & Reading.

*Fry, "The History of North Atlantic Steam-Navigation."
†*Fairplay*, London, June 20, 1901, p. 1005.
‡*Railroad Gazette*, 1905.

tion. New York, being a city with much paving, with a good harbor, and near many other cities requiring asphalt, is a convenient base for the operation of an asphalt company. This large traffic is much like that in oil. A line of steamers has succeeded irregular vessel movements and now regularly carries asphalt from Trinidad to Perth Amboy on New York bay. There is even some effort made to have the ships get return freight and thus develop, as a strictly side issue, the services of a common carrier for the out voyage. The same company that operates the asphalt steamship line is constantly in the ship market to charter steamers on the single trip basis, to handle any sudden increase of traffic for New York or to send a special shipment to other ports in the United States or foreign countries. The amount of this irregular shipment is very great, because of the fact that the paving contracts are constantly being let and executed in scores of cities, necessitating a very wide and constantly shifting field of operation for the paving companies and their steamship traffic, which is all managed from a common center.

The production of anthracite coal in Pennsylvania has led to operations on a large scale. It is well known that the larger share of the coal is owned and mined by railroad companies, which get most of their income from coal freights. Much of the coal sent to New England goes thither in the company's coal fleet, which is regularly employed in plying between Philadelphia, Boston and other New England points. This fleet consists of powerful tugs and barges or sea lighters that transport several million tons a year. The enormous extent and the divided ownership of the soft coal lands of the United States have not yet resulted in any such organization of the soft coal traffic, but it is within the bounds of probability that steel barges will carry coal down the Ohio and Mississippi rivers, and across the Gulf and the Caribbean to soft coal markets along those shores in a manner analogous to the shipping of anthracite to New England. The present aggressive action of railroads in taking possession of bituminous coal lands in the Ohio valley indicates that they will be in a position to take up this barge traffic if they so desire.

The traffic on the American Great Lakes is not classed as maritime, but the only difference is a matter of 3 per cent. of salt in the water and a barrier that keeps the lake ships from extending their voyages to sea. In its economic essentials it is sea traffic, and in the magnitude of the commerce, the size of the ships, and the waters traversed, it ranks with, and in some respects outranks the commerce between England and the nearby Continent. This lake commerce should be discussed here because it possesses the world's most thoroughly organized and largest example of an industrial steamship line.

The United States Steel Corporation manufactures iron and steel in Pittsburgh from ore brought a thousand miles from mines beyond the western end of Lake Superior. This company owns the ore mines, the coal mines, coke ovens and lime stone quarries necessary to produce all of the raw material used. It also owns and operates the necessary railroads and steamship lines to carry all of these materials to the points of manufacture. The lake ore fleet must carry many million tons per year, and, owing to the ice of the winter, it has only about seven months in which to do the year's work. The largest of these ore vessels carry about 12,000 tons of cargo, while 8,000 and 10,000 tons are very common sizes, and the new vessels are usually of largest type. This one company owns and employs in its own business over 200 vessels with an aggregate tonnage that puts it in the class with the second rate maritime powers. No ocean fleet in the world except the oil fleet equals this in the speed with which its vessels are loaded and unloaded. The work is practically all done by gravity and machinery, and the ratio of the time the steamers are actually under way doing the work of going from port to port to the time they are at the docks has no equal in the general commerce of the salt seas. At the end of each lake and at other places there are opportunities for the giving of telegraphic orders to the captains of the vessels. The ease of communication, combined with the great number of the steamers, and the fact that they connect with the company's railroads at each end of their route enables one man in his Pittsburgh office to manage this whole fleet, and order the vessels from place to place and dock to dock, as a train despatcher manages the trains on the tracks under his control. These lake ore steamers, sometimes carrying coal on the return voyages, are as absolutely a part of the steel company's industrial organization as is a blast furnace or an overhead crane in a mill.

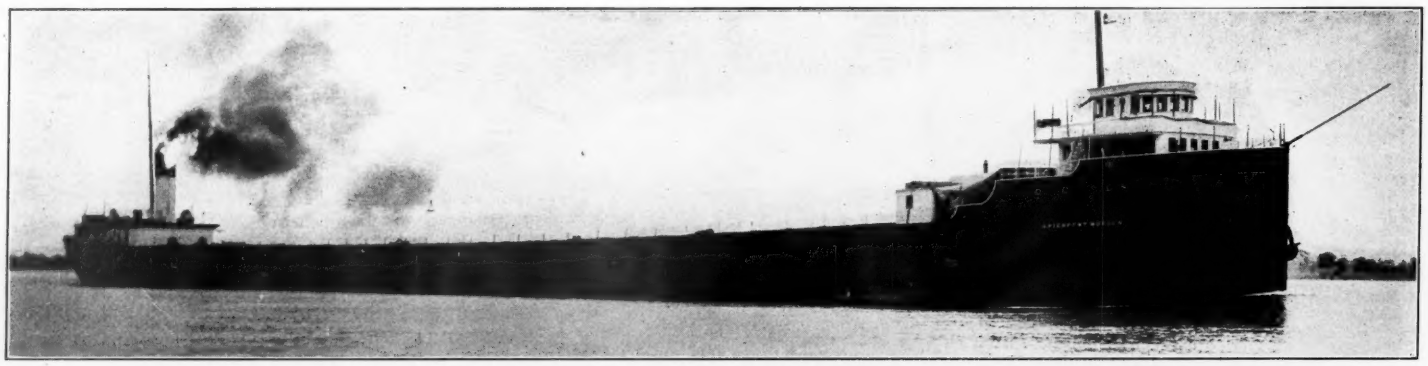
What is to be the future of the industrial or merchant steamship line? Is it to be eliminated again as was the merchant carrier of the eighteenth century? Probably not. The present private operator seems to be large enough in his operations to hold his own and grow and keep up with the growth of the ocean steamer.

The operating unit in each of the industries mentioned in this chapter seems to be enlarging and, therefore, becoming more able to maintain among its activities a private transportation system. The trade in tropical fruits especially is one showing rapid increase. It was stated on the best authority in 1901 that the imports of bananas had doubled every five years for 30 years.

Many forms of tropic agriculture adapt themselves to the type of large scale production above described. Sugar plantations on the coast of Peru are owned by firms having steamship lines to New York, where the sugar is marketed. The sugar plantation is a late addition to the list of activities of the firm. It began as an exporting house, but the late addition of productive industries is a suggestive move. In Chile the nitrate for export is sometimes carried in lines of vessels belonging to the firms manufacturing the nitrate.

These examples of incidental combination of ocean transportation and production, taken in connection with the more formally organized services mentioned above, are suggestive of the continued growth of this form of organization in ocean transportation.

(To be continued.)



J. Pierpont Morgan; United States Steel Corporation Fleet on the Great Lakes.

Before the Telegraph Was Invented.

To compare the present with the ancient means of communication is to appreciate that you are living in the commercial twentieth century.

One of the first systems of aerial telegraphy was attempted in the fifteenth century. The originator was Amontons, at that time considered one of the cleverest scientists of the world. He developed a system of signal telegraphy so that a message could be sent from Paris to Rome in three hours. Those who assisted in the transmission of the message along the line were unable to tell the nature of the message.

Posts were placed from Paris across the Alps at consecutive points, where men were stationed with telescopes. Different signals, representing combinations of letters, were run up at each post. The man at the other end, seeing the signal, placed a similar one before his post, and so the message was carried to its destination. The key to the signal was known only to those who sent the message in Paris and the recipients a thousand miles away. Amontons was not encouraged in his work by the puffy, gouty functionaries of the time and discontinued his efforts.

Perhaps the real inaugurators of the system of long-distance transmission of messages were the Gauls. If you leave your office some afternoon and see a friend across the street and cry, "Oh, there!" you are using a system of telegraphy in vogue in Europe until 1792. The cry of "huppa," from which the English "Oh, there!" was derived, was the mouth telegraphy of the ancient Franks, by which they sent a message at the rate of 150 miles a day.

A number of men, stationed at certain intervals over a long stretch of country, sent messages, one to the other, so quickly that Caesar, in his Commentaries, said the natives forwarded warnings of his approach at the rate of 50 leagues from sunrise to sunset.

At night they used signal fires or "hauchees." While tympans were beaten, fires were lighted from mountain top to mountain top.

To the tourist wandering through France and over the Pyrenees into Spain the old towers which appear from time to time across the mountain may seem purposeless and strange. Yet they are vestiges of the greatest system of old time aerial telegraphy in existence. These towers—both square and round—are situated on the most prominent hillocks. Up to 1844—when experiments assured the success of the electric telegraph—these towers were the means of communication in France. In that year there were 535 stations. The towers were two stories high, with index signals of light wood or iron mounted at the top of a pole on the roof.

This system was originated by Claude Chappe, and was presented to the National Assembly of France on March 22, 1792. Chappe had prepared a secret vocabulary composed of 9,999 words, represented by characters. The convention conducted a series of trials, and, elated by what its members called the simplicity of the scheme, adopted it.

At that time France was at war with nearly the whole of Europe. The first telegraphic national message was received by Carnot, grandfather of a recent French president, telling of the restoration of Conde to the Republic.

The news of the taking of Brussels by the French was transmitted from that city to Paris in 25 minutes. Messages were sent by placing signals at the top of the poles on the towers. The telegrapher at the one end mounted a ladder and changed them by hand. There was always someone on watch on the towers to note the signals from the others. The line of stations was extended by the first Bonaparte to Milan, Italy, and thence to Mayence, Germany. As the French army retreated the telegraph posts were destroyed.

During the Crimean war (1854) a system of sending messages by the use of semaphores was adopted, by which messages were conveyed from one camp of the allied armies to another. Arms extended from a framework of wood, which could be operated by wires by a man below in a tent. By lifting or lowering the arms messages were sent from one division to another.

While the efficiency and success of the electric telegraph was assured by 1850, and wires were strung up all over Northern France, it was not until the end of that year that they were opened for public use. Even when private individuals were allowed to send messages, they were required to give proof of their identity, but the secrecy of the despatches was considered inviolable. A few months after the wires were given for public use the first submarine cable was laid.—*Express Gazette.*

Foreign Railroad Notes.

The latest development in Russian passenger traffic is the use of counterfeit tickets. These, it is said, neither the gatemen nor the train ticket collectors are usually able to distinguish from genuine tickets. A train ticket collector who had that ability recently found 140 counterfeit tickets on one train! The holder of one of them protested by shooting the collector, who, however, escaped with his life and the 140 counterfeit tickets.

That traffic may grow even in the "effete European despotisms" is shown by a statement of the number of cars and locomotives on the railroads of Prussia and Hesse (which are worked as one system, under one management) since 1893. We give below the numbers at five-year intervals:

	1894.	1899.	1904.	1908.
Locomotives	10,715	12,460	14,837	18,306
Passenger cars	17,871	22,674	27,393	34,910
Baggage cars	4,648	5,861	7,222	10,327
Freight cars	218,033	276,933	310,653	393,998

From 1894 to 1908 there has been an increase of 70 per cent. in locomotives, 95 per cent. in passenger cars, 123 per cent. in baggage cars, and 87 per cent. in freight cars. There has doubtless been a large increase in the tractive capacity of locomotives since 1894, and some increase in freight car capacity.

In the United States, with a much more rapid increase in population and railroad mileage, the rolling stock has increased as follows:

	1895.	1899.	1902.	1906.
Locomotives	35,699	36,703	41,225	51,672
Passenger train cars.	33,112	33,850	36,987	42,262
Freight cars	1,196,119	1,295,510	1,546,101	1,837,914

The "year" here ends with June. The figures thus begin six months later and end 18 months earlier than those for the Prussian railroads. The increase in locomotives for the 11 years here was 44 per cent., against 70 per cent. for the 14 years in Prussia; the increase in passenger cars 28 per cent. here and 31 per cent. there; the increase in freight cars 54 per cent. here and 87 per cent. there. The increase in engine and freight car capacity has doubtless been much greater here than there since 1894; though it began here much earlier than that year.

The Metal Tie.*

BY DR. ING. A. HAARMANN.
Geheimer Kommerzienrath.

In January, 1892, 16 years ago, I discussed in this place, "The Use of Metal and Wood in Permanent Way." To-day, permanent way, as such, is not my theme. I shall confine myself to the examination of only one of its parts, the tie, for it seems to me that the time has come that metal should get its due recognition as a material for supporting rails.

Our society has, for a long time, been deeply interested in clearing up the points connected with this subject. I need only refer to the illuminating work of Bueck, of Brauns and of Beukenberg. In the same way the various German railroad managements and the "Verein für Eisenbahnkunde" and the "Stahlwerks-Verband" have labored for a more general use of the metal tie. The paths followed may not always have been the best. Even in our own ranks many occupied the untenable position that the field of activity of the manufacturer of iron and steel was limited to the production of good rails or ties following the specifications furnished by railroad managements, while their design was solely the concern of the railroad engineer. I am the last to deny or to minimize the propriety of collaboration on the part of the railroad officer in so important a matter; on the contrary, I have often pointed out, in this society and elsewhere, that hearty working together of both is necessary. Indeed, I am convinced that the prominence which metal permanent way has attained in Germany, and especially in Prussia, is due to this very collaboration.

For the information of those who think it premature to speak of the existence of a recognition of the capabilities of the metal tie, I will preface my remarks with some statistics. I will not go back further than 1898, as the figures prior to that date are arranged on a different basis.

TABLE 1.—*Comparisons of the Mileage and the Number of Wooden and Metal Ties in the Standard Gage Tracks of Germany.*

Fiscal year.	Standard gage track—Wooden ties, miles.	Standard gage track—Metal ties, miles.	Percentage of metal tie track to Wooden track. Total track.	Percentage of metal tie track to Wooden track. Wooden tie.	Number of Wooden ties.	Number of Metal ties.	Percentage of metal ties to Woodn ties. Total.	Percentage of metal ties to Woodn ties. Wooden tie.
1898.	28,479	10,005	25.9	35.0	56,250,330	19,904,493	26.1	35.4
1899.	29,243	10,344	26.0	35.4	57,748,211	20,616,468	26.3	35.7
1900.	29,914	10,687	26.3	35.7	59,326,504	21,490,912	26.6	36.2
1901.	30,680	10,948	26.3	35.6	61,459,928	22,272,430	26.6	36.2
1902.	31,484	11,247	26.3	35.6	63,434,161	23,066,490	26.7	36.4
1903.	32,166	11,515	26.4	35.8	65,224,411	23,908,406	26.8	37.7
1904.	32,526	12,057	27.0	37.7	66,351,513	25,226,882	27.5	38.0
1905.	32,932	12,491	27.7	38.0	67,885,129	26,575,507	28.1	39.1

TABLE 2.—*Number of Ties Used for Reconstruction and Renewals on the Standard Gage Tracks of Germany.*

Fiscal year of	Number of Wooden ties.	Number of Metal ties.	Cost of ties—Wooden, per 100.	Cost of ties—Metal, per ton.
1898	4,218,007	1,443,230	$99.84	$22.18
1899	4,199,690	1,498,707	107.52	23.31
1900	4,355,415	1,743,298	108.00	24.44
1901	4,305,014	1,654,241	110.64	24.88
1902	4,342,440	1,929,561	104.64	23.81
1903	4,280,468	1,727,890	105.60	23.81
1904	4,013,003	1,954,447	106.56	23.56
1905	4,126,828	2,098,611	106.04	24.44

TABLE 3.—*Wooden and Metal Ties in Service in the Tracks of the Prussian and the Prussian-Hessian State Railroads.*

Fiscal year of	Wooden ties—Total No.	Wooden ties—Per mile.	Metal ties—Total No.	Metal ties—Per mile
1898	35,991,584	1,926	11,992,182	1,920
1899	36,829,657	1,950	12,576,920	1,936
1900	37,799,131	1,959	13,201,525	1,955
1901	38,880,771	1,966	13,689,567	1,982
1902	40,099,309	1,985	14,552,280	2,005
1903	41,856,235	1,995	15,499,252	2,032
1904	42,321,031	2,005	16,551,418	2,055
1905	43,338,050	2,032	17,730,362	2,100

In 1892 the ratio of length of track laid with metal ties to track with wooden ties was 30.2 per cent.; in 1898 the ratio had increased to 35 per cent., and in 1905 to 38 per cent.

Table 3, giving the total number of ties in the tracks of the Prussian State Railroads, is of particular interest. By referring to columns 3 and 5, it will be noted that the number of ties per mile has steadily increased to keep up with the greater demand of traffic, but that the rate of increase has been more marked in the case of the metal tie. This is due to the more rapid increase of these latter in recent years. The result is that there are relatively more metal ties in the newer sections of track over which fast trains requiring closer tie spacing pass, while in the older sections, on which traffic is not so heavy, there are more wooden ties. Thus the specifications of the Prussian State Railroads for 1905 required 2,467 ties for tangents and 2,576 for curves per mile of track. This proved increase in the use of metal ties is in no way the result of arbitrary preference. Had not the metal tie been markedly improved from the structural point of view, no amount of unmerited preference could have enabled it to compete successfully with the wooden tie.

Judging from a recent address by the secretary of the asso-

*Address delivered at the meeting of the "Verein der deutschen Eisenhüttenleute," Dec. 8, 1907, at Düsseldorf. Reprinted from *Stahl und Eisen*, by permission.

ciation for furthering the use of wooden ties, there is a tendency among its advocates to champion its cause in a narrow, partizan spirit. The railroads have, in a sense, become public property, and the public is vitally interested in their development. It demands that their operation be in accord with the laws of economics, that the maximum of safety attainable be secured, and that a track be provided over which trains may pass smoothly and with the least possible jar. As the public, so the railroad management is interested in these matters, and as the constituted guardian of safe and economic operation it must satisfy these demands. Only after they have been satisfied is it reasonable to consider particular interests such as forestry, the wood industry or the iron and steel industry.

To get a clear conception of the development of the tie, it will be profitable to present illustrations of some of the most characteristic exhibits in the Track Museum at Osnaburg, taken from my work on railroad track.

Fig. 1—Cast Iron Rails on Stone Blocks at Merthyr Tydfil, Wales, 1804.

The beginning was stone. The first metal railroad track was built of cast-iron angles fastened to blocks of stone. Fig. 1 shows a section of the track used by Trevethik at Merthyr Tydfil, in southern Wales, more than 100 years ago, for the notable trials of his primitive locomotive with flangeless wheels. The stone blocks, while of various shapes and sizes, still furnished fixed points for the support of the yard long angles of cast iron. In spite of the small strains to which they were subjected, they were not able in practice to remain long in service. The line of rails was only a chain made up of short links on which the primitive "iron horse" pounded along. There was no thought given to joint connections, or stiffness or distribution of pressure, etc.; every stone support in carrying the load had to be sufficient unto itself.

Twenty-five years later George Stevenson, whom we rightly call the father of railroads, and who with his "Rocket" opened a new

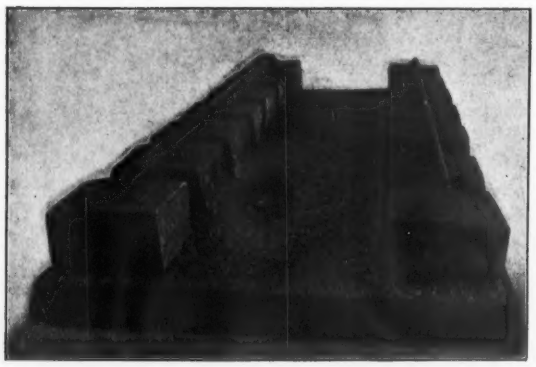


Fig. 3—Mushroom Rails on Stone Ties; Nuremberg-Fürth Line, 1835.

era in railroading, improved on this method. He introduced regular shaped stone for the rail supports, and used a rail (designed by Birkenshaw and originally rolled with fish bellies) that reached over five stone blocks (Fig. 2). In spite of firm tamping these blocks gradually settled and the difficulty of tamping them condemned them as not fit for the work. But they were not abandoned at once, their inherent qualities of resistance to atmospheric influences and to compression securing them adherents for a few years longer. Our first public steam railroad, the line from Nuremburg to Fürth, opened in 1835, was provided with stone blocks (Fig. 3). Following this, a number of small lines in Bavaria were built with them, some retaining them up to a comparatively recent time; they were provided, however, with wooden ties at the joints (Fig. 4). Wooden

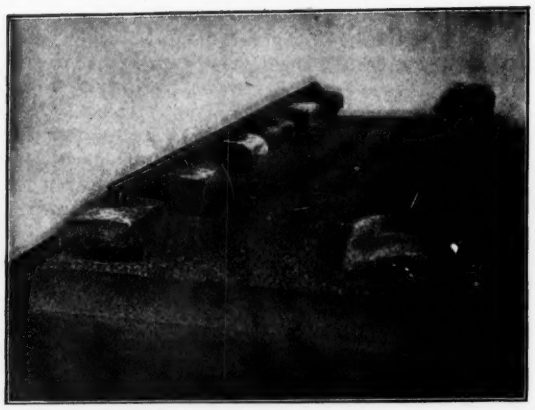


Fig. 2—Fishbelly Rails on Stone Ties; Stockton-Darlington Line, 1825.

ties, binding together the two strings of rails and furnishing a larger bearing surface, were evidently so superior to stone blocks that they soon reigned supreme in railroad construction.

Thus stone gave way to wood. In the early decades of modern railroading, the shape and dimensions of the wooden tie varied considerably. At that time there was ample room for choice of wood, both as to kind and age, and the price was comparatively low. It was not uncommon to cut six ties out of one section of a tree, while to-day a single tie is the rule. Unfortunately, no ties of this early period have come down to us, and we are unable to determine by personal inspection their weaknesses and defects. For the purpose of studying the changes due to weathering and to mechanical wear, we must content ourselves with specimens that have been taken out of the track in recent years, after having seen service. For a long time it has been one of the important problems of the railroad engineer to minimize the effects of weather and wear. The illustrations show clearly the depression and wearing away of the tie at the places where the rail was in contact with it.

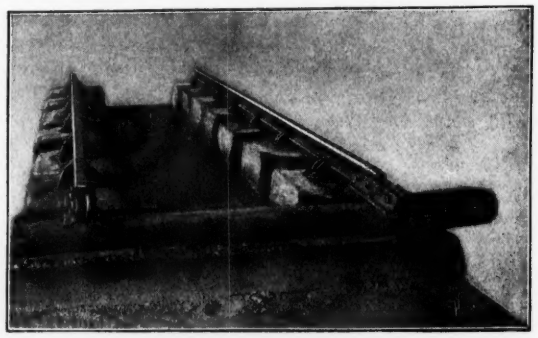


Fig. 4—Chair Rails on Stone Ties; Bavarian Railroads, about 1850.

In addition, we have the splintering and crushing caused by spikes and screws, effects that are more evident in the original specimens in the Track Museum at Osnaburg.

The rapid introduction of wooden ties in Germany dates from the building of the railroad from Dresden to Leipsig in 1838 (Fig. 5). The broad-flanged rails were laid directly on the wooden ties, being the first use of this enticingly simple method of construction which has remained the model for Germany and for many other countries. In the same year, in the construction of the London-Birmingham Railway, Robert Stevenson used a track consisting of double-headed rails supported on cast-iron chairs resting on wooden ties. The English have held fast to this chair-rail system and it is in use at the present day.

A few samples will illustrate the development of the wooden tie permanent way. First, I will call attention to a section of track with broad-flanged rails that was in service between Copenhagen

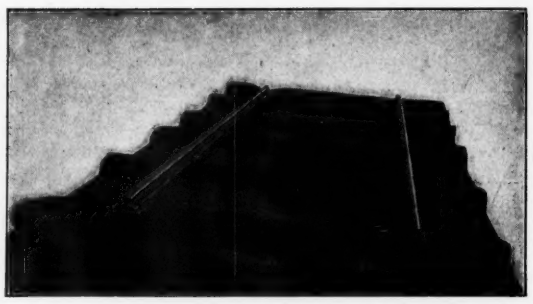


Fig. 5—Broad-Flange Rails on Wooden Ties; Leipsic-Dresden Line, 1838.

and Roskilde for 11 years, 1847 to 1858 (Fig. 6). The cross ties are fir and the rails are fastened to them by spikes; they have butt joints and one of the oldest styles of splicing, only one splice bar, and that on the outside. For 15 years, 1870-1885, track such as shown in Figs. 7 and 8 was in use. The considerable wear on the impregnated fir tie, especially where no tie plates were used, is apparent, and, indeed, small plates placed under the joints did not afford much protection (Fig. 8).

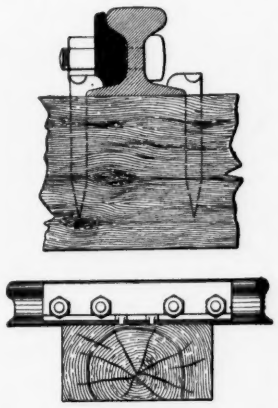


Fig. 6—Rail Joint with Single Splice Bar; Copenhagen-Roskilde Line, 1847.

The reason for the rapid introduction of tie plates is evident on examining Figs. 9 and 10. Fig. 9 shows an impregnated fir tie that had been in service from 1875 to 1885, and on which the rail had rested directly. The great diminution of cross section at the points of contact due to the repeated resurfacing or spotting of the tie is very noticeable; its neighbor (Fig. 10) of the same wood suffered less, on account of the plate with which it had been provided. Worthy of note are the attempts made to counteract the splitting of the ends of ties, especially beech ties, by means of wooden dowels or metal screws and clamps (Figs. 11 and 12).

Wooden ties, rather irregular in shape and size but closely spaced, are found on American roads (Fig. 13). The rails are spiked to the ties and, of late, tie plates are being used more liberally. A sample of the Pennsylvania Railroad's track is of interest as showing the staggered joint system of laying track in vogue on many American roads. This track arrangement, with 14 white oak ties of tolerably uniform dimensions under rails 30 ft. long and weighing 100 lbs. to the yard, is probably the heaviest in America and has been in use for 12 years on lines with very heavy traffic. Undoubtedly when the track is in perfect condition the staggered joint system furnishes a better bond and diminishes somewhat the jar. As an offset, the number of jars is doubled and, after a while, with fast running trains lateral as well as vertical oscillations of the cars are produced. The advantage of this system is rather doubtful, and this would especially be the case in comparison with a track laid with opposite joints, in which, with the joints supported by appropriate ties, the jar would be very slight, if noticeable at all.

The Pennsylvania is undoubtedly one of the best built, most carefully maintained and best operated roads in North America. The life of its ties, as I was informed, is seven years, and replacements are made almost constantly. The ties taken out of the track, in spite of the comparatively short time of service, are in such condition that their use for other purposes, especially if they have to be transported any considerable distance, would not be profitable. On this, as on other American roads, the ties are either simply dumped over an embankment and allowed to rot, or they are burned. Some important divisions of the Pennsylvania, e.g., that between Philadelphia and Altoona, have four tracks, the two inner serving for freight, the two outer for passenger traffic. Standing on the rear platform of the train it is an impressive sight to watch the mighty freight trains, with their 50-ton cars, following each other in rapid succession.

Fig. 14 illustrates the combination of Goliath rails and impregnated oak ties introduced on the Belgian State Railroad in 1893. At the joints, the horizontal flanges of the angle splice bars take the place of tie plates. We have no permanent way with wooden ties that equals the American and Belgian construction in weight

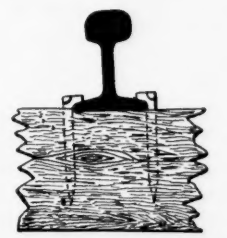


Fig. 7. Intermediate Tie without Tie Plate, 1870-1885.

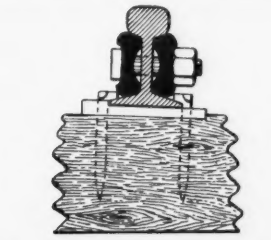


Fig. 8. Joint Tie with Tie Plate, 1870-1885.

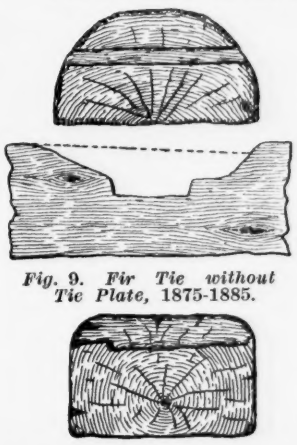


Fig. 9. Fir Tie without Tie Plate, 1875-1885.

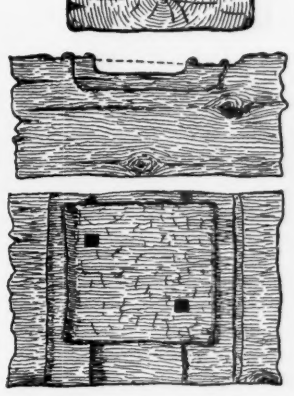


Fig. 10. Fir Tie with Tie Plate, 1884-1894.

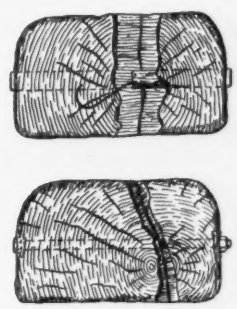


Fig. 11—Beech Ties with Wooden Dowels, Metal Clamps and Screws.

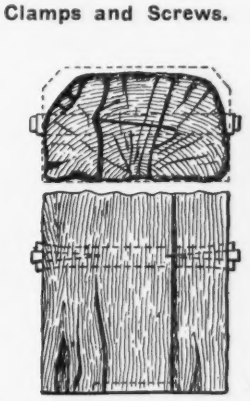


Fig. 12—Beach Tie with Wooden Dowels and Metal Clamps.

Wear of Tie Under Rail Seat; Cologne-Hamburg Line.

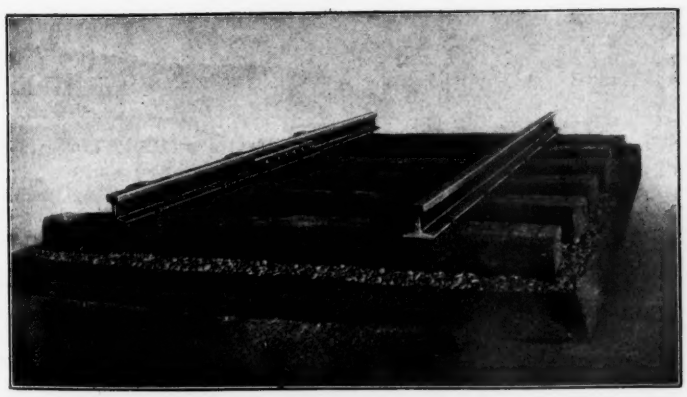


Fig. 13—Close Tie Spacing and Heavy Rails; Pennsylvania Railroad, 1895.

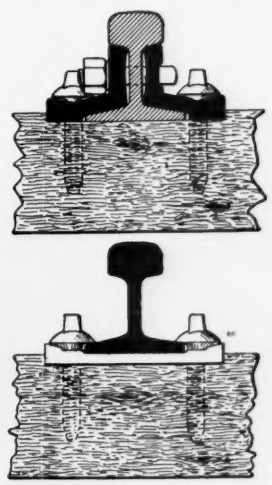


Fig. 14—Heavy Rails and Large Tie Plates; Belgian State Railroads, 1889.

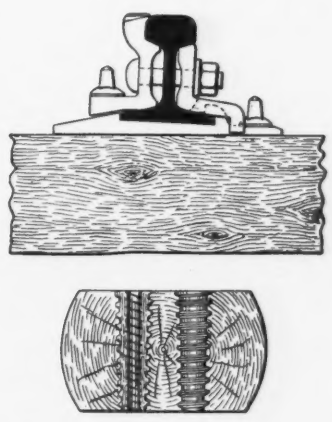


Fig. 15—Hardwood Dowels in Fir Tie; Bavarian State Railroads, 1900.

of metal, although the Bavarian track of 1900 (Fig. 15) makes a very respectable showing. The comparatively heavy rails and the tie plates of this permanent way certainly afford a better protection to the ties than do the hardwood dowels. These last, on account of the large holes required, weaken the tie, and the repeated tightening of the screw spikes ultimately strips the wooden thread.

The Prussian permanent way of 1892 has large plates at the joints and smaller ones on the intermediate ties (Fig. 16). At present the latter are only used in connection with oak ties. It is well known that more recently the Prussian State Railroads,

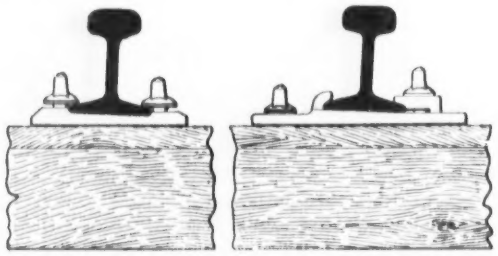


Fig. 16—Intermediate and Joint Ties; Prussian State Railroads, 1892.

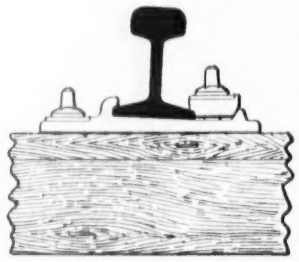


Fig. 17—Heavier Rails, 1905, and Hook Plates with Long Ribs, 1907, on Fir Ties; Prussian State Railroads.

on the lines serving for express trains, employ a rail with a larger profile, No. 15, weighing 90½ lbs. per yard and supported throughout on large plates resting on ties spaced 24¾ in. between centers. The weight of metal per lineal yard of completed track is 257½ lbs. (Fig. 17).

Since 1893 the Prussian government has made comparative tests with the materially heavier chair-rail system of the English roads, following the construction of the Midland Railway. The ties are not so thick as those customary in Germany, but are wider. The illustration (Fig. 18) shows the line between Minden and Bückeberg, which, ballasted with river gravel, was operated for 9¾ years. This gravel is not the best kind of ballast and is probably responsible for the very marked wear of the ties by the chairs (Fig. 19), greater than is usually the case in England. There, as now with us, crushed stone predominates on express tracks, no matter what kind of ties are used. So far, the trial has not demonstrated the economic advantage of the English permanent way with chair rails. The newer English constructions are still more massive In 1896, the Midland Railway introduced a permanent way having 98-lb. rails, 55-lb. chairs and a total of 340 lbs. of metal per lineal yard of track (Fig. 20). The line between Derby and London, serving for very fast and heavy trains, is of this construction. From recent personal experience, I know that the track rides smoothly and is quite free from jars, a condition due in a great measure to the considerable weight of metal and to the good distribution of pressure. Still, as the joints are distinctly noticeable even when riding in the large corridor cars of the fast trains, I am convinced that securing the butt joints with flat splice bars would not suffice were it not for the heavy chairs. If these chairs, in spite of their great weight and large bearing surface (108 sq. in.), do not protect the wooden ties, it is not surprising that plates, the largest and heaviest of which have not half the bearing surface and one-quarter the weight of the chairs, should prove inadequate when used on wooden ties in conjunction with flange rails. In time they invariably grind into the tie, and the spikes or screws become loose; tightening these, adzing the tie and renewing the fastenings become necessary from time to time, until finally the ties are no longer fit for service. With the greater demands made on the permanent way, this goes on at a steadily increasing rate in spite of all the protective measures that have been employed. The average life of wooden ties does not increase; it decreases, while its cost fluctuates but does not become cheaper; the offerings of the better grades of ties lessen, but the demand, naturally, is steadily becoming greater. Repeated trials with beech ties have not given encouraging results. The untreated, or, following older methods, the insufficiently treated, beech tie, while presenting an apparently sound exterior, decays in the interior, so that in the course of a few years the inside is utterly rotten. It is hoped that this serious defect will be remedied by better methods of treatment, but while satisfactory results are uncertain, increase in cost is sure. We in Germany are not alone in being affected by an increase in the cost of ties. From my notes of a recent trip to the United States, I find that ties which in 1893 cost 45 to 50 cents apiece are now (1907) selling for 95 cents, an increase of 100 per cent., and with the steady diminution of the forests, a further increase is to be expected. English roads, I am informed, obtaining their supply from Norway and Sweden, are paying $1.10 to $1.22 per tie.

The increasing difficulty of supplying our requirements, together with the problems connected with properly fastening the rails so as to meet the greater strains to which a steady increase of load subjected the permanent way, made it imperative to consider the availability of a substitute for the wooden tie, one that would better meet all requirements. Thoughtful economists early recognized this and pointed out that to neglect the protection of the forests was markedly unthrifty, as far as the interests of agriculture were concerned. In this connection, the query naturally arises whether, in view of the progress in the iron and steel industry, the importation of large quantities of ties from foreign countries could be justified? The reply that the iron and steel industry, just as the wood industry, does not confine itself to utilizing the natural resources of our country but also works up large quantities of foreign ores, is not convincing to the earnest investigator. In the case of iron ore, we have to do with a raw material that is made to furnish an increase to our national wealth by German intelligence, by German work and by German capital. Then against that importation of iron ore is the offset of the export of iron. The excess of imports during the last five years has averaged 10 per cent. of the total quantity smelted in Germany. Moreover, this foreign material not only does not compete with the product of domestic mines, but is of advantage to it since the rich Spanish and Swedish ores mixed with the lower grade German ores enable larger quantities of the latter to be smelted. Finally, that answer does not apply because our country is deficient in ore supplies, both in quantity and quality, and because we lack a substitute of domestic origin to take the place of the ore. It must also not be forgotten that foreign wood is steadily deteriorating owing to the disappearance of the old trees, the quality of whose heart wood is not being attained by that of the younger growth. Moreover, the more complete utilization of the wood of the forests for a great variety of purposes is increasing the difficulty of obtaining good ties. Although the decrease in the resisting power of the wood is being remedied, more or less successfully, by the use of larger and heavier tie plates and by screwing in hardwood plugs, yet this increases the cost to such an extent that only the superiority of this system can justify its adoption.

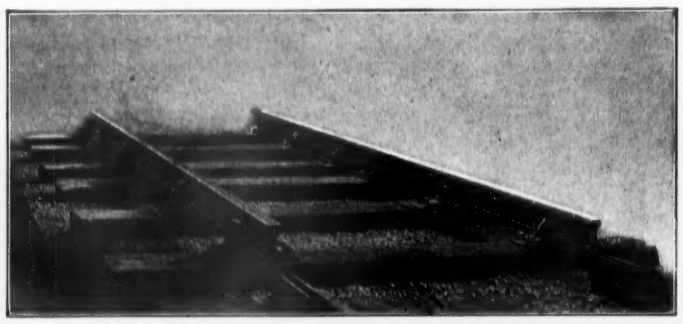


Fig. 18—Heavy Cast Iron Chairs on Fir Ties; Minden-Bückeburg Line, 1893-1903.

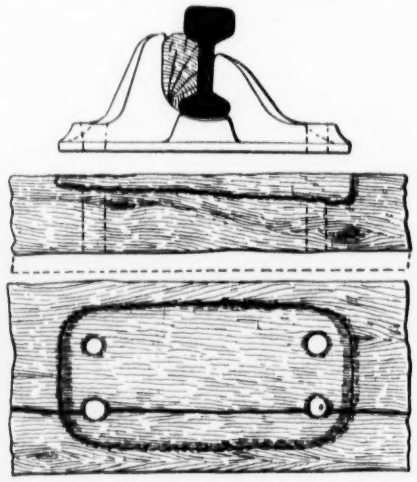


Fig. 19—Wear of Tie Under Chair; Minden-Bückeburg Line, 1893-1903.

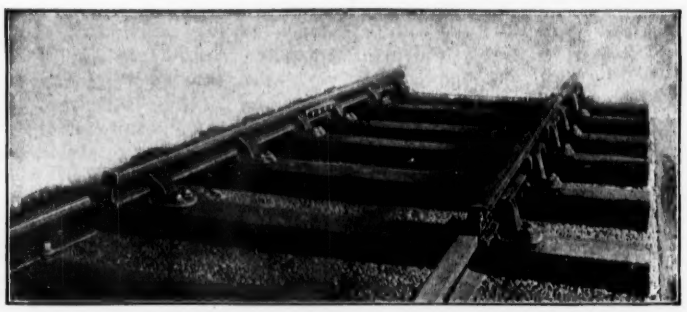


Fig. 20—Heavy Rails and Heavy Chairs on Oak Ties; Midland Railway, 1896.

(To be continued.)

GENERAL NEWS SECTION

NOTES.

The Louisiana Railroad Commission in its annual report, March 11, asked the state legislature for a large increase of power.

The mail car on the Oriental Limited was robbed on March 15 near Bonners Ferry, Idaho, by a lone robber dressed as a post office inspector.

Announcement is made that the Baltimore & Ohio resumed all construction work on improvements in the Pittsburgh district, March 16.

The General Manager of the San Pedro, Los Angeles & Salt Lake is quoted as saying that 30,000 carloads of oranges will be shipped east this spring.

Roads in the Western Passenger Association have lowered their excess baggage rate from 18 per cent. to 16⅔ per cent. of the regular single-trip passenger rate.

The Cincinnati, New Orleans & Texas Pacific has laid off a large number of shopmen, following the refusal of the men to accept a 10 per cent. reduction in wages.

The Pennsylvania will run over the Buffalo & Allegheny Valley division a train with special apparatus to instruct farmers in the scientific growing of corn and alfalfa.

The Western Passenger Association has authorized a stopover of thirty days in Chicago on all tickets sold to summer tourists to all parts of the West, North and South.

The Brooklyn Rapid Transit Co. announces that on March 11, between 5 and 6 o'clock in the afternoon, 340 trolley cars made the round trip over the Brooklyn bridge and back.

It is announced that the Chicago & Alton has not renewed its contract with the United States Express Co., but has made a new long-time contract with the American Express Co.

The Texas Railroad Commission believes that the railroads are dismissing more employees than is necessary and proposes to take action if further reductions are made in working forces.

Five chiefs of national organizations of railroad employees are now in Washington trying to prevent the enactment of any legislation which will reduce further the earnings of the railroads.

Mississippi railroads have been ordered by the state commission to require their passenger conductors to reserve an extra seat for women passengers accompanied by an infant or young child.

The up-state New York Public Service Commission has appointed a public hearing on April 13 to consider complaints about commutation rates for service within the suburban zone of the New York Central.

The St. Louis & San Francisco pleaded guilty to 13 indictments charging the road with granting rebates to a Kansas City lumber company, and on March 11 was fined $1,000 on each count, the minimum penalty.

On March 16 the state of Oklahoma withdrew from the suit to dissolve the alleged merger between the St. Louis & San Francisco and the Rock Island, that part which asks that a receiver be appointed for the Frisco.

The lower house of the Mississippi legislature has passed a 2½-cent railroad rate bill applicable to all railroads except those that can prove that this rate is not just compensation, but it is not believed that it will become a law.

On March 12 representatives of the American Traveling Men's League argued in Washington that interchangeable thousand-mile mileage books good on any road in the country be required by law to be sold on a 2-cents-a-mile basis.

Employees of the Big Four have been advised by circular letter that wage pay checks must not be cashed in saloons, but that the money must be collected upon them at one of the banks designated in the letter. The order has stirred up a good deal of protest.

E. H. Harriman and O. H. Kahn have appealed to the Supreme Court of the United States, the decision of the Circuit Court requiring them to answer certain questions regarding the ownerships of stocks in the Chicago & Alton, Illinois Central and other railroads.

Arthur Hale appeared before the railroad committee of the Massachusetts legislature, March 11, and argued against the reciprocal demurrage bill, which provides for the payment of a dollar per car per day for failure to deliver cars within four days of the time ordered, and for a demurrage charge of the same amount to be paid by the shipper in case the car is not unloaded within 96 hours.

On March 10 the railroads of Kansas appealed to the United States Circuit Court for a restraining order enjoining the Kansas Board of Railroad Commissioners and the state attorney from putting into effect on April 1 the schedule of maximum freight rates ordered by the board of February 14.

The Central Vermont has been fined $1,000 by Judge Holt of the United States Circuit Court of the New York district for granting a rebate on a shipment of coffee from Boston to Western points. There were seven counts in the indictment and the road pleaded guilty to one of them on which this fine was based.

The Receiver of the New York City Railway Co. announces that 155 pay-as-you-enter cars will be installed on the Fourth and Madison avenue line before April 1. The cars accommodate 75 persons comfortably and it is not proposed to allow any more on board, though how this theory is to be carried out in rush hours is not stated.

On March 16 1,500 machinists, boiler makers and other shop employees of the Denver & Rio Grande went on strike. The new shop rules, which were rejected by the men, provided for the payment of all employees according to individual merit, regardless of maximum or minimum scales, the right to change shop rules without consultation with employees, a graduated scale of wages, refusal to give specific recognition to union men and other open shop features.

On March 16, Justice Davis, of the New York Supreme Court, awarded damages to a property holder claiming trespass against the Manhattan Elevated Company in building and operating a third track on Ninth avenue, on the ground that the legislative authority granted the railroad to build and operate a double-track elevated railroad in front of the plaintiff's premises made no provision for a third track, and that the building of this third track interfered with the plaintiff's easement.

The Attorney-General has prepared a report alleging that the Oregon & California Railroad has violated the terms of the grant under which it secured large holdings of land from the government. The report says that the railroad secured about 3,800,000 acres of government land under condition that the land so granted should be sold to actual settlers only, in quantities not greater than one-quarter section to one purchaser and for a price not exceeding $2.50 an acre. The Attorney-General alleges that in making sales the railroad company has always observed the law of supply and demand and has never obeyed the law of Congress.

On March 16 the Supreme Court of the United States again upheld the validity of the Elkins anti-rebate law in a decision sustaining the conviction of the Armour, Swift, Morris and Cudahy packing companies for accepting rebates on packing house products, and of the Chicago, Burlington & Quincy for granting them. Each of the five defendants were fined $15,000. The court was divided five to three. Justice Moody took no part, while Justice Brewer delivered a dissenting opinion for himself, Chief Justice Fuller and Justice Peckham. Justice Brewer's dissent was based largely on the question of contract right. He asked who would engage in any new enterprise or invest money in a manufacturing industry if he knew that he could not make a definite contract for rates of transportation to and from his factory, but was advised that whatever contract he might make was liable, at the whim of the carrier, to be set aside and a higher rate imposed.

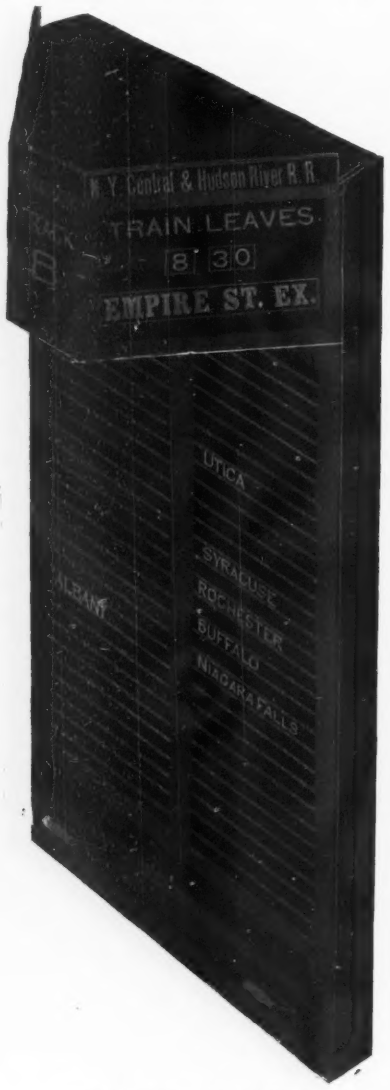
Editorial Manager for American Society of Mechanical Engineers.

Lester G. French has been put in charge of the editorial department of the American Society of Mechanical Engineers. Immediate improvements are to be begun; one of them is the establishing of departments in the monthly proceedings, thus providing a greater variety of technical articles of interest. Other features are planned and it is hoped that the value of the Proceedings will be much increased. All such papers, however, will, as formerly, first be presented and discussed before the society. Mr. French was born in Keene, N. H., in 1869. At an early age he worked under his father, who was the publisher of "The Vermont Phoenix," at Brattleboro, Vt., and a partner in a large printing establishment in that place. In 1891 Mr. French took his degree in mechanical engineering at the Massachusetts Institute of Technology. After four years' apprenticeship, drafting room and shop experience, principally at iron foundry shops in Providence, he wrote several text books. He

then became one of the editors of *Machinery*, and for nine years was editor-in-chief. Mr. French has recently published text books on Algebra and Applied Mechanics and a treatise on Steam Turbines.

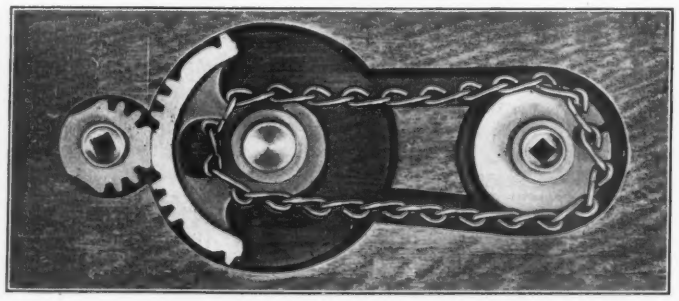
The Boynton Station Indicator.

The first Boynton indicator was put on the market in 1883. During the last few years it has been modified to provide for a larger number of station and train names. The indicators recently put up at the Grand Central Station in New York were an improved type, and a still later design is to be used in the new Hoboken terminal of the Lackawanna. One of the accompanying photographs shows the indicator used in the Grand Central Station. It differs from the first type installed in this terminal in that the upper part, which shows the name of the road, the leaving time and the train name, projects so that it can be read from any part of the concourse; in the older type, this portion was flat and could be read from in front only.



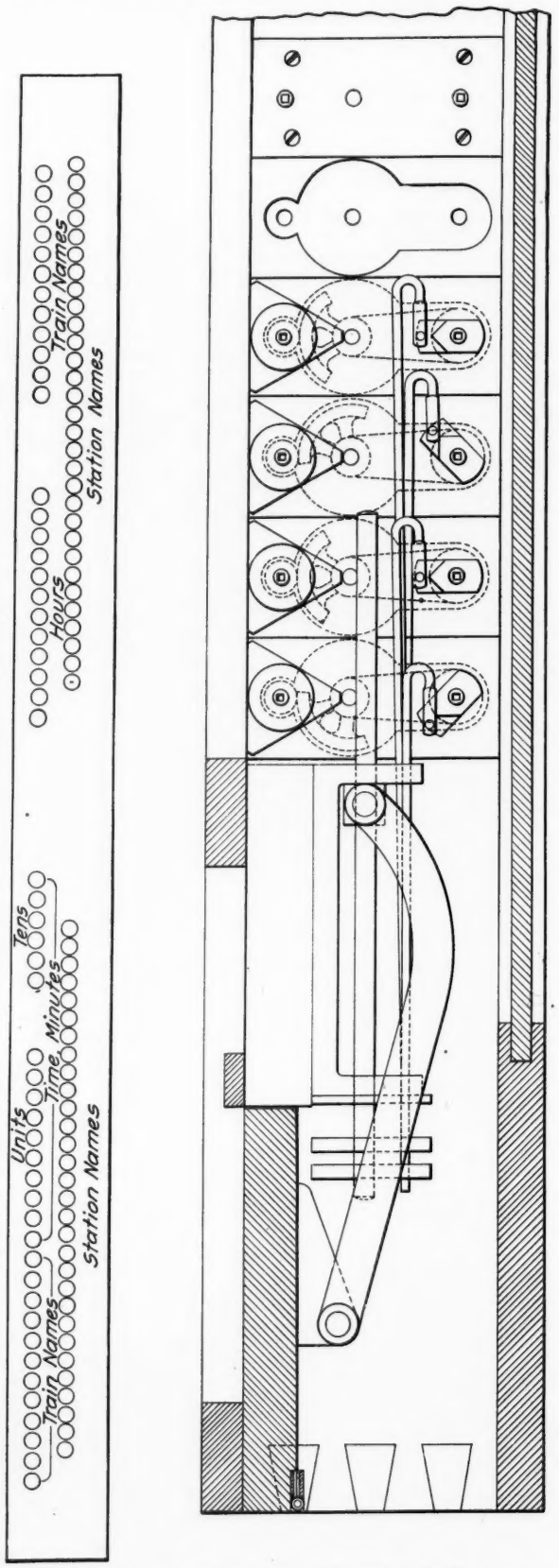
Boynton Train Indicator.

The accompanying drawing shows a vertical section of the newest design of indicator. The three-sided slats are blank on one side and bear station names on the other two sides. Each is revolved by a quadrant and pinion gear, driven by a chain from a rocker shaft to which a vertical wire is connected by a bell crank. The lower ends of the wires are centered over holes in bed plates extending the width of the machine. The bed plates are raised by closing the door at the bottom of the indicator. A perforated card of stiff pasteboard is laid on one of the bed plates. Where there is a hole in the card, the wire passes through the bed plate as the latter is raised and the slat is not revolved. Therefore it still shows blank. Where no hole is punched, the card lifts the wire and moves the slat. When the card is laid on the upper bed plate, the slat is turned through 240 deg.; when on the lower, the movement is only 120 deg. This drawing shows slats in all three positions; this does not occur in practice, as only one card is used at a time, making possible but two positions. The slats could take the three positions shown only if cards were laid on both bed plates at once. There is a separate card for each train, and one can be used until the time-table is changed. The makers furnish a matrix from which blank cards can be printed and the holes then punched out. The drawing shows a card for an indicator in which there are two columns of station names. The card has 60 station name spaces, so that with three-sided slats 120 stations can be shown (by putting the card on the upper or lower bed plate) or 180 stations if four-sided slats, with three bed plates, are used. The latter is the type at the Grand Central Station. The card shown herewith has also spaces for train names, which are on revolving slats, and for time; the hours and minutes are on slides and the time is shown by lifting the proper slides according to the combination punched out on the card. The names of the railroads using the terminal are on revolving cloth curtains, which are not operated automatically.



Pinion and Quadrant Mechanism; Boynton Indicator.

Each quadrant and pinion is enclosed in a separate wooden box. As shown in the accompanying photograph of a model of one of these units, the cogs at three points on the quadrant and the pinion are replaced by smooth surfaces, convex and concave, respectively. These lock the slat in position, and also allow enough play at these points to compensate for errors in adjustment of the operating wires, which, if ordinary gearing were used, would leave the visible side of the slat out of parallel with the front of the indicator. Each slat may be removed for relettering without disturbing the rest of the mechanism.



Card and Vertical Section of Boynton Indicator.

These indicators are made by the Boynton Indicator Co., 1307 Pembroke street, Bridgeport, Conn.

Blackwell's Island Bridge.

The Blackwell's Island bridge, from East Fifty-ninth street, Manhattan, to Long Island City, was on March 18 connected from end to end by placing a steel girder in the bottom chord of the span over the east channel of the East river. The bridge was begun in 1901. The contract for the steel superstructure was awarded to the Pennsylvania Steel Co. in 1903 and the masonry piers and anchorages were completed in 1904.

The total length of the bridge is 8,231 ft. The roadway of the river span is 143 ft. 3 in. above mean high water. On the lower floor of the bridge is to be a roadway 53 ft. wide between curbs and four trolley tracks. On an upper floor will be two elevated train tracks and two footpaths, each 13 ft. wide. The width of the bridge is 88 ft. The weight of steel in the superstructure is 52,000 tons, and the cost, including land and approaches, will be about $20,000,000.

Transcontinental Traffic via Tehuantepec.

The agents of the American-Hawaiian Line of steamers claim that freight now moves from New York to San Francisco *via* the Isthmus of Tehuantepec as fast as it moves all-rail. According to the *Journal of Commerce*, the company's schedule of weekly sailings from New York shows delivery of freight in California in 26 days. Cargo is transshipped at Puerto Mexico (Coatzacoalcos), Mex., over the Tehuantepec National Railway, a distance of 180 miles, to Salina Cruz. The freight is handled at the Isthmus rapidly and carefully and delivery at destination shows that transshipment of cargo can be made without damage. From Salina Cruz freight is forwarded by connecting steamer to San Diego, San Francisco, Seattle and Tacoma.

The steamship company operates three services:

1. New York, Puerto Mexico.
2. Salina Cruz, Puget Sound, Hawaiian Islands, returning to Salina Cruz.
3. Local service between San Francisco, Puget Sound and the Hawaiian Islands.

The line carries practically all the sugar shipped from the Hawaiian Islands to Philadelphia and New York, and will shortly operate a regular eastbound service from Pacific coast ports to New York. It has modern piers at Tehuantepec and modern appliances for handling cargo.

The steamers of the Pacific service burn oil, thus demonstrating its success as fuel.

Following is the company's fleet:

Steamers—	Tons.
Atlantic Service.	
American	8,000
Californian	8,000
Hawaiian	8,000
Oregonian	8,000
Isthmian	6,000
Pacific Service.	
Alaskan	12,000
Arizonan	12,000
Columbian	12,000
Missourian	12,000
Mexican	12,000
Texan	12,000
Virginian	12,000
Nebraskan	5,000
Nevadan	5,000

The new westbound schedule follows:

	Due to arrive				
Sailings from New York:	San Diego or Los Angeles.	San Francisco.	Portland.	Seattle or Tacoma.	Hawaiian Islands.
March 7 and 14	Apr. 9.	Apr. 13.	Apr. 20.	Apr. 22.	May 9.
March 21 and 28	Apr. 23.	Apr. 27.	May 4.	May 6.	May 23.
April 4 and 11	May 7.	May 11.	May 18.	May 20.	June 6.
April 18 and 25	May 21.	May 25.	June 1.	June 3.	June 20.
May 2 and 9	June 4.	June 8.	June 15.	June 17.	July 4.
May 16 and 23	June 18.	June 22.	June 29.	July 1.	July 18.
May 30 and June 6	July 2.	July 6.	July 13.	July 15.	Aug. 1.
June 13 and 20	July 16.	July 20.	July 27.	July 29.	Aug. 15.
June 27 and July 4	July 30.	Aug. 3.	Aug. 10.	Aug. 12.	Aug. 29.

The rolling stock of the Tehuantepec National, both passenger and freight, is in good condition. Some of the latest passenger coaches are included, and Pullman cars are provided for service between Santa Lucretia and Salina Cruz. In view of the growth of the traffic, actual and prospective, the number of freight cars is being rapidly increased. Recently there were 929 box cars, 120 gondolas (each of 30 tons capacity), 60 stock cars and 50 locomotives. The Tehuantepac National was the first railroad in the Republic of Mexico to burn oil for fuel on its locomotives. It now has 14 oil-burning locomotives, and 23 others are being adapted to burn oil as rapidly as the shops can change them. Oil is found to be about 30 per cent cheaper than coal or wood. The company at present obtains its oil from Beaumont, Texas. It is loaded on to tank steamers at Port Arthur, Texas, and is delivered at Coatzacoalcos, where the company has a 1,500,000-gal. steel storage tank, from which it is distributed to smaller supply tanks along the line, each having a capacity of 6,500 gallons. Before long it is expected that the locomotives will be burning oil obtained from local oil wells. Already the stationary boilers in the company's shops at Rincon Antonio are burning oil from the Isthmus.

When Pearson & Son took up the contract, Salina Cruz had merely an open roadstead. Now the Pacific port of the Tehuantepec National has a sheltered outer harbor of about 20 acres, and an inner dock basin capable of taking the largest vessels.

The saving in distance of the Tehuantepec route over Panama is shown by the following table in nautical miles:

	Via—	
New York to—	Tehuantepec.	Panama.
San Francisco	4,226	5,495
Acapulco	2,363	3,613
Mazatlan	3,017	4,055
Yokohama	8,666	9,835
Honolulu	5,699	6,688
New Orleans to—		
San Francisco	3,091	4,700
Acapulco	1,262	2,861
Mazatlan	1,759	3,458
Liverpool to—		
San Francisco	7,182	8,038
Acapulco	5,274	6,035
Honolulu	8,511	9,263
Yokohama	11,478	12,500

Anthracite Coal Production.

As in previous years of depression following panic the anthracite coal demand has stood up extremely well. The following comparative figures are shown of anthracite output per month:

Month.	1907-08.	1906-07.	1905-06.
November	5,666,205	5,182,153	5,421,584
December	5,343,477	4,836,028	5,395,113
January	5,618,339	5,249,946	5,458,084
February	4,503,756	4,563,720	4,712,099
Total	21,131,777	19,831,847	20,986,880

The stock of coal at tidewater on October 31, 1907, was 819,757 tons, and on February 29, 1908, it was 700,404 tons, so that as far as these figures indicate, the consumption of coal was greater than the supply. To arrive at an accurate result as to consumption, it would be necessary to have the state of stocks at interior points, but these are not available.—*Wall Street Journal.*

The Short Line Railroad Association.

The Short Line Railroad Association, which is endeavoring to increase the mail compensation of short line roads, was incorporated last October under the membership corporation law of New York state. The purpose of its organization is to protect and promote the business interests of short line railroads engaged in the transportation of mail, passengers and freight, doing business in this and other states; to advocate and use its influence in the enactment of just and equitable federal and state laws to govern these railroads; to establish social and commercial relations between short line railroads for the betterment of the same and for the economies which can be practised.

In December last the association appointed a legislative committee for the purpose of taking action in regard to increasing the pay for railroad mail transportation and also for the purpose of doing away with the mail deliveries beyond railroad terminals; also to look after and oppose all legislation inimical to the railroads, particularly the independent short line roads represented by the association.

For the accommodation of the committee and to promote the work of the association, headquarters were opened in Washington and an active campaign has been carried on there in favor of the passage of a bill which was prepared by the association and introduced in Congress. This bill does not interfere in any way with compensation paid the longer or trunk lines; it simply covers the minimum rates.

Previous to 1876, all roads carrying the minimum quantity of mail received $50 per mile per year for carrying 200 lbs. of mail per day, while roads carrying 500 lbs. received $75 per mile per year. In 1876 Congress made a reduction of 10 per cent. from the rate then allowed, and this was followed two years later by a further reduction of 5 per cent. The result is that short lines, or roads carrying 200 lbs. of mail per day, are now receiving $42.75 per mile per year, while those carrying 500 lbs. receive $64.13 per mile per year.

Many of these short line roads carrying from 500 to 1,000 lbs. of mail per day supply apartment space from 10 to 25 ft., equipped with post office accommodations, also carrying a messenger to distribute the mail and receive no compensation whatever for the use of their car space nor anything for heating or lighting the car. They are also compelled to deliver their mail from the terminal of the railroad to the post office or postal station, no matter what the distance may be. It is claimed that there are roads in the organization

receiving from $400 to $500 a year that disburse more than two-thirds of that amount to cover the messenger service.

The three principal changes suggested in the bill are as follows:

That the roads carrying not more than 500 lbs. of mail per day over the entire route shall be paid $75 per mile per year; that they shall not be required to deliver the mails at a post office or a postal station unless it be located in the railroad depot or station of the carrier; that the Postmaster-General shall be authorized to allow for space used for post office purposes in compartment cars on roads where the daily average weight of mail carried does not exceed 500 lbs. a proportion of the rate of compensation allowed for postal cars forty (40) feet in length. For the use of these cars the longer or trunk lines are allowed 5½ cents per mile.

Report on Boston & Maine Merger.

The Commission on Commerce and Industry, authorized by the state of Massachusetts to report on the proposed merger of the Boston & Maine with the New York, New Haven & Hartford, finds that the New Haven holds 109,948 of the 302,928 Boston & Maine shares, which it is now by law disqualified from voting, and makes the following recommendations:

1. The New York, New Haven & Hartford Railroad Company to be permitted to hold and acquire stock of the Boston & Maine Railroad and vote thereon, and to be required to exchange its own stock, share for share, for all stock of the Boston & Maine Railroad that may be offered for exchange prior to July 1, 1909.

2. The Boston & Maine Railroad and the New York, New Haven & Hartford Railroad Company to be and remain subject to all the provisions of the laws of this Commonwealth which are now applicable to them respectively and not inconsistent with the act now to be passed.

3. The rates for the transportation of freight or passengers within, across, into or from this Commonwealth by any steam railroad or street railway or steamship line controlled by either of said companies not to be increased or the facilities therefor diminished without the approval of the Board of Railroad Commissioners, so far as it is within the power of this Commonwealth to regulate such transportation.

4. The principal office of the Boston & Maine Railroad and the control of its operation in this Commonwealth to be in Boston, its principal managing officers to be residents of this Commonwealth, and every director to be a resident of some state in which the company is incorporated.

5. All stock of the Boston & Maine Railroad at any time owned by the New York, New Haven & Hartford Railroad Company, or in which it has any interest, to stand of record in the name of the latter company; and, unless with the permission of the Railroad Commissioners, given after a public hearing, not to be disposed of or encumbered, or affected by any contract, arrangement or understanding in respect to its ownership, use or control, and not to be voted on, except for the choice of directors, unless in pursuance of a vote of the directors of the New Haven Company communicated to and approved by the Board of Railroad Commissioners prior to the meeting at which the stock is to be voted.

6. No conveyance, contract, agreement, arrangement or understanding to be made by the Boston & Maine Railroad or by the New York, New Haven & Hartford Railroad Company for the acquisition or use by any third company of any of the road, tracks, terminals or equipment of either of the said two companies, or of any of those of a third company by either of said two companies, or for the exchange of business, unless with the approval of the Board of Railroad Commissioners.

7. If at any time subsequent to December 31, 1913, the growth, development, maintenance or management of any of the railroads now operated by the Boston & Maine Railroad shall not be satisfactory, or shall not adequately meet the requirements of the public and the interests of the Commonwealth, and if the Board of Railroad Commissioners shall so certify to the Governor and Council either of its own motion or in response to an inquiry from the Governor or the Legislature, then the Commonwealth shall be entitled to buy all the stock of the Boston & Maine Railroad owned or controlled by the New York, New Haven & Hartford Railroad Company at a price to be determined as prescribed in the act now to be passed.

8. If at any time the substantial control of the New York, New Haven & Hartford Railroad Company shall pass to any other corporation, by lease, consolidation, change in the ownership of stock, contract, understanding or arrangement, and if the Board of Railroad Commissioners shall so certify, then the Governor may notify the New Haven Company that the stock of the Boston & Maine Railroad acquired by it shall not be voted on, and such prohibition shall continue until removed by the Board of Railroad Commissioners, with the approval of the Governor or the Legislature.

9. There shall be permitted a reciprocal use by the New York, New Haven & Hartford Railroad Company, the Boston & Maine Railroad and the Boston & Albany Railroad Company, of their respective terminal facilities in and near the city of Boston, including tracks, docks, vacant land and water front, and also of the Commonwealth property at South Boston, to such extent and manner, upon such terms and for such compensation as may be for the public advantage; the matter to be determined in the manner provided in the act now to be passed.

Proposal to Sell Steinway Tunnel to New York City.

The New York City Public Service Commission announces receipt of a letter from the Interborough Rapid Transit Company offering to sell all the tunnel railroad and rights, excluding certain real estate of the New York & Long Island Railroad Company, known as the Steinway tunnel, at its actual cost to the Interborough company for construction, etc.; a cost estimated at about $7,000,000, to be paid in city bonds, and proposing that the city enter into an operating contract with the New York & Queens County Railway Company to operate the tunnel in connection with its surface railroad in Queens county for a term of 25 years at a 5-cent fare, the city to pay half of a certain sum agreed upon to represent operating expenses, and the balance to be met by the company; the city to take the local fares until reimbursed for its advances for operating expenses and interest on bonds issued to pay for the tunnel and 1 per cent. for a sinking fund; the company to take the through fares and, when the city has been reimbursed, the local fares to be divided equally between the city and the company. The counsel to the commission is of the opinion that this proposal is one for the decision of the city authorities concerned with the expenditure of public money. If the city authorities look upon it with favor, the matter may later come before the commission for its approval under the provisions of the law. But the present form of the Rapid Transit act gives to the commission no power which would allow the purchase of an existing railroad or tunnel with public money, and the Rapid Transit act would have to be amended to grant any such authority for the purchase of a railroad or tunnel instead of building it at public expense, and to provide for any such co-operative arrangement for operating and taking of fares in lieu of a guaranteed rental as now provided to cover interest and sinking fund for bonds issued to pay for the public improvement.

Better Feeling in Maryland.

State Senator Gorman, of Maryland, leader of the Democratic majority, has strongly advised against any adverse railroad legislation. Governor Crothers, in commenting on the Western Maryland receivership, finds a warning to Congress and to the legislatures of the states that the railroads are in no condition to withstand the assaults of adverse legislation or to endure increased burdens and decreased revenues. The Governor is quoted as saying that it is a bad time for 2-cent rate bills. Attorney-General Straus believes that legislatures and other government agents should realize the grave peril of legislation adverse to the railroads and the danger of indiscriminate attacks upon financial and public service institutions. President Seth, of the state senate, believes that it is time that legislatures try to assist the railroads through their troubles, and that they should refrain from oppressive and injurious action.

INTERSTATE COMMERCE COMMISSION RULINGS.

Shippers Held to Their Agreement.

The Commission has announced decision (opinion by Commissioner Cockrell) in the case of Laning-Harris Coal & Grain Co. and Kansas City Hay Co. vs. St. Louis & San Francisco. It appeared that certain shippers applied for cars in which to ship hay, which the carrier, because of car shortage, could not furnish at the time and place desired. The carrier informed the shippers that it had certain cattle cars which it could furnish if the shippers would clean and suitably prepare them for their shipments of hay at their own cost and expense. The shippers accepted these cars on these terms, cleaned and prepared them, and shipped their hay therein, and then claimed reparation for the cost and expense incurred by them. Upon the foregoing statement of facts the Commission held that the shippers' claim for reparation be denied and their complaint dismissed.

Through Route and Joint Rate Established.

The Commission, opinion by Commissioner Prouty, has announced decision in the case of F. J. Gentry vs. Atchison, Topeka & Santa Fe et al. The complaint alleged that defendants failed to establish a through route and joint rate on lumber, lath and shingles from Ashland, Tex., to Nash, Okla. It appeared that there formerly existed joint rates over two established routes between these points, but that they have been recently canceled. The Commission de-

cided that there is no satisfactory through route or joint rate for the shipment of such commodities between said points, and that a joint through rate of 28½ cents per 100 lbs. should be established over a through route specified in the decision.

Class Rates to Pecos, Tex., Upheld.

The Commission, opinion by Commissioner Clements, has announced decision in the case of Pecos Mercantile Co. vs. Atchison, Topeka & Santa Fe et al. The complaint alleged that the class rates of defendants for transportation of commodities from Chicago, St. Louis, Omaha and Denver to Pecos, Tex., are unreasonable as compared with rates from said points of origin to El Paso, Tex. The Commission declared that it is unable to find that the class rates now in effect from said points of origin to El Paso, Tex., unduly prejudice Pecos, or that the lower rates from such points of origin to El Paso constitute a violation of the fourth section of the Rate Law as that section is construed by the courts. Complaint dismissed.

Reparation Because Low Rate Temporarily Suspended.

In the case of North Bros. vs. St. Louis & San Francisco (opinion by Commissioner Cockrell) it appeared that the defendant carrier for some years had a proportional rate of 15 cents per 100 lbs. on hay when carried from Kansas City, Mo., through a part of the state of Kansas, to Cape Girardeau, Mo. This rate was canceled and a higher rate went in effect for a short time. Thereafter the 15-cent rate was restored. During the time the higher rate was in effect complainant shipped two carloads of hay over the route named. The Commission decided that the rate in excess of 15 cents per 100 lbs. on hay in carloads shipped under the circumstances named is unjust and unreasonable, and that North Bros. are entitled to an order for reparation.

Roads Built for Special Purpose May Charge Higher Rates.

The Commission, opinion by Commissioner Prouty, has announced decision in the case of the American Asphalt Assoc. vs. Uintah Railway. The Commission decided that under the peculiar circumstances of this case a rate of $8 per ton is a reasonable charge to be imposed by the Uintah Railway for transportation of gilsonite, a low-grade commodity, for a distance of 54 miles. The former rate of $10 per ton was declared unreasonable. The Commission further held that where a railroad has been built for a special purpose, and does not form part of any general industrial development, it does not stand in the same relation to the public as a railroad chartered and built for general purposes, and the reasonableness of its rates must be determined by the financial returns which they produce rather than by comparison with rates in effect elsewhere.

No Reparation for Misrouting by Shipper.

The Commission, opinion by Commissioner Prouty, has announced decision in the case of Hollis Stedman & Sons vs. Chicago & North-Western et al. In February, 1904, complainant shipped three carloads of potatoes from Wautoma, Wis., to Springfield, Mo., via the Chicago & North-Western, the Illinois Central and the St. Louis & San Francisco, and paid the combination of locals rate of 38½ cents per 100 lbs. The complainants insisted that this rate was unreasonable, because the shipments might have been made from Wautoma to Springfield over other lines for 25 cents per 100 lbs. The Commission held that the higher charge was due solely to complainants' error and that the Commission has no jurisdiction to establish a joint through rate, since a satisfactory one already exists, and that the rate charged is not found to be unreasonable in itself. If these shipments had been routed via St. Louis instead of via East St. Louis, the rate would have been 1½ cents less per 100 lbs. The Commission said that the Illinois Central was at fault in billing the shipments to East St. Louis instead of to St. Louis, and should make good this overcharge.

Car Shortage Answers Complaint of Discrimination in Car Supply.

In the case of Wagner, Zagelmeyer & Co. vs. Detroit & Mackinac and Michigan Central (opinion by Chairman Knapp), the complaint alleged that since July 13, 1906, the Detroit & Mackinac has discriminated against complainant in furnishing cars for interstate shipments of ice from Tobico, Mich., and the rates charged by defendant on ice from Tobico to points in Ohio are unreasonable. It appeared that the evidence clearly establishes and complainants submit that prior to September 15, 1906, the service was satisfactory, and since that time and continuing until after January 1, 1907, a car shortage, amounting to famine of freight transportation facilities throughout the country after October 1, 1906, existed. This car shortage, which prevailed on the Detroit & Mackinac in common with all other railroads, was brought about by circumstances over which that company had no control and for which it was not responsible. There was no evidence that the joint rates on ice from Tobico to Toledo and Cleveland are unreasonable. Under these circumstances the Commission held that complainants were not unduly prejudiced in their car supply, and that the joint rates on ice from Tobico to points in Ohio are not shown to be unreasonable *per se* or relatively. Complaint dismissed.

Joint Rates and Combination Rates.

In the case of the Laning-Harris Coal & Grain Co. vs. Missouri Pacific and Wabash (opinion by Commissioner Lane) it appeared that two cars of coal were shipped by complainant from Springfield, Ill., to Kansas City, Mo., via the Wabash, and after arrival at Kansas City one car was forwarded by complainant to Salina, Kan., and one to Kipp, Kan., both via the Missouri Pacific. The joint rate on coal from Springfield to Salina or Kipp via Kansas City is $3.73 per ton, whereas the combination rate is $3.50. On the foregoing shipments defendants charged and collected the higher joint rate. On complaint that this charge is unreasonable, the Commission held that these shipments consisted of strictly local shipments into and out of Kansas City, and that the application of the joint through rate was not in accordance with the published tariffs, but that the lawful rate applicable on such shipments was the combination of locals. Reparation was awarded.

The Commission further declared that there can be but one legal rate between two points. This rate must be either the local rate if over one road, or the joint rate if over a through route composed of two or more roads which have agreed to a joint rate, or a combination of separately established rates applicable on through business over a through route which does not enjoy a joint rate. In general, said the Commission, joint through rates are lower than the sum of the locals between two points, and obviously there can seldom be any transportation reason why this should not be the case.

Intra-State Private Cars as Affecting Interstate Car Supply.

The Commission, opinion by Commissioner Harlan, has announced decision in the case of Henry Ruttle et al. vs. Pere Marquette. The rulings of the Commission in this case are as follows:

While the right to use private cars may doubtless be denied to shippers by appropriate legislation, in the absence of a specific enactment to that effect the Commission is not prepared to say that their use in itself is unlawful; but if their use results under a given set of circumstances in an unlawful advantage to their owners and an unlawful disadvantage to other shippers, a question is presented which under existing legislation is within the control of the Commission and may be made the basis of such relief as the facts may justify. Because of defendant's insufficient equipment, a number of worn-out cars no longer serviceable for interstate movements were acquired and fitted up by certain shippers for the transportation of their hay from local points on the Port Austin division of the Pere Marquette to junction points with other lines, where the hay was transferred to empty system cars and moved forward to eastern markets. The Commission held, on the foregoing state of facts, that defendant's course in stopping its own cars as well as the cars of connecting carriers in its control at such junction points there to be loaded with hay from the "private" cars, instead of sending them up the line to the loading points where all shippers might share in their distribution, was to the detriment and at the expense of complainants and other independent dealers, and amounted to a denial to the complainants of the equal enjoyment of the facilities of defendant and was therefore an unlawful discrimination.

Unreasonable Rates Should be Paid and Reparation Sought.

The Commission, opinion by Commissioner Clements, has announced decision in the case of Coomes & McGraw vs. Chicago, Milwaukee & St. Paul and Chicago, Rock Island & Pacific. Complainant shipped over defendants' lines from Elk City, Okla., seven carloads of broom corn to Sioux City, Iowa, via Omaha, paying 60.85 cents per 100 lbs. on one car, 80.5 cents per 100 lbs. on another car, and on the remaining five cars $1.14 per 100 lbs. The combination of locals on this commodity from Elk City to Sioux City, based on Omaha, is 60.85 cents per 100 lbs., whereas the joint through rate was at the time of the shipments $1.14; but subsequently defendants voluntarily established a joint through rate of 60.85 cents. Pending protest against paying the $1.14 rate on two of these cars, unloading was delayed, causing demurrage charge, which was paid by complainant.

The Commission held that the joint through rates of 80.5 cents and $1.14 were unjust and unreasonable, in so far as the same ex-

ceeded the sum of the locals, and awarded reparation on that basis; but reparation on account of demurrage charges was denied. The Commission declared that rates duly established are binding on carriers and shippers alike so long as they remain in effect. The law requires that such rates shall be reasonable and just and authorizes the Commission to award reparation on account of the exaction of unreasonable transportation charges. It follows that although a rate is by the terms of the law binding on all so long as it remains in effect, such rate may be found and declared to be unlawful and reparation awarded on account of its exaction. To hold otherwise would be to make the mere establishment of rates by a carrier conclusive of their reasonableness and justness and leave shippers without recourse for recovery of excessive charges. It is the duty of carriers and shippers to observe the established rates, and there can be no waiver of demurrage charges which accrue by reason of the refusal of consignees to accept shipments and unload cars pending a contest or dispute as to the reasonableness of the established rates.

Present System of Compression Points for Cotton Upheld.

The Commission, opinion by Commissioner Clements, has announced decision in the case of the Chickasaw Compress Co. vs. Gulf, Colorado & Santa Fe et al. and of the Pauls Valley Compress & Storage Co. vs. the same defendants. The complainants in these cases, owning cotton compresses at Ardmore and Pauls Valley, Okla., respectively, alleged that the practice of defendants whereby cotton originating at points north of Ardmore and Pauls Valley is carried by those points to Gainesville, Tex., for compression, while cotton originating south of Gainesville is not permitted to be carried north through Gainesville to Ardmore and Pauls Valley for compression, results in unjust discrimination against them; and asked that the Commission establish a rule requiring defendants to have all cotton compressed by the compress nearest the point of origin. The Commission declared that carriers are permitted to adjust their rates, regulations and practices with due regard to the circumstances and conditions confronting them and the natural currents and laws of trade and commerce.

It appeared that cotton would not move from points in Texas south of Gainesville northwardly into Oklahoma for compression at Ardmore and Pauls Valley unless the rate to Ardmore and Pauls Valley should be as low as the rates to Gainesville. This would be true whether or not a higher rate were in effect from the compression point. It would also be true of all points as far south of Gainesville as the distance that cotton may be moved to Gainesville from points north of Ardmore and Pauls Valley, Okla. To require the rates from these points of origin in Texas south of Gainesville to be the same to Ardmore and Pauls Valley, Okla., as to Gainesville, Tex., would be to entirely disregard the added expense of the back haul. The movement of cotton is almost entirely southward from all points on defendants' lines, and cotton originating at points north of Ardmore and Pauls Valley naturally moves through Gainesville. To require the defendants to haul cotton northwardly through Gainesville for compression at Ardmore and Pauls Valley, and to protect on such shipments rates not higher than those in effect from points of origin to ultimate destinations, where such cotton must be ultimately hauled back through Gainesville to southern ports would not be justified. The Commission decided that the discrimination complained of is not undue. Complaints dismissed.

Prosecution to be Begun for Alleged Rebating and Destruction of Records.

The Commission, through Commissioner Lane, makes the following report in regard to a hearing in Richmond, Va., on February 19, 20 and 21, 1908, from which the following facts appear:

1. For some years a fraudulent practice, participated in by certain dealers in grain and also by certain dealers in packing house products and also by the Chesapeake & Ohio, has obtained at Richmond by means of which this railroad company has favored such shippers at the expense of the Seaboard Air Line and Atlantic Coast Line, its southern connections. This practice has resulted in obtaining for such shippers rates less than local rates over the Seaboard Air Line and Atlantic Coast Line for shipments of grain and also for shipments of packing house products, which local rates such shippers were legally bound to pay. This result has been accomplished by means of transfer slips issued by the station agent of the Chesapeake & Ohio on the written instruction of the Assistant General Freight Agent, said transfer slips falsely conveying to the southern lines the statement that such shipments had originated at points beyond Richmond and were entitled to move from Richmond to destination in the Carolinas at a division of a through rate, such division being less in amount than the local rates to which these shipments were legally subject.

2. The benefits of this arrangement have been reaped by the shippers enjoying it and also by the Chesapeake & Ohio, which, whether by express agreement or not, has received all of the inbound business of the shippers so favored by it.

3. It also further appears that the Assistant General Freight Agent of the Chesapeake & Ohio responsible for the above described abuse on discovering that the same was under investigation by special agents of this commission undertook to make amends for the same to the Seaboard Air Line and the Atlantic Coast Line. To this end he ordered that a list be prepared of all cars which had by his orders been moved at a division of the joint through rate less in amount than the local rates to which they were legally subject. Being informed by one of his subordinates that this list would be a very long one, he then gave orders that the list should show only the cars moving during the months of August, September and October, 1907. Having been furnished with a list covering these three months he forwarded it to the southern lines with a statement that it showed "all" cars so misbilled which he had been able to discover.

4. It also appears that certain records of the Chesapeake & Ohio have been destroyed, contrary to the provisions of the Rate Law. The testimony showed that the freight claim department of this road is under the charge of the Assistant General Freight Agent, he being the officer responsible for the false transfer slips. The testimony further shows that the auditor of disbursements on receiving from the freight claim office claims from shippers with direction that they be paid inquires no further into the merits or legality of such claims than to ascertain from the auditor of freight receipts that the shipments to which the claims relate have moved and that the charges have been collected. All claims so passing through the freight claim office and paid on the order of the Assistant Freight Agent prior to January 1, 1907, were destroyed during the latter part of the year 1907. This destruction appears to have been made by the auditor of disbursements under authorization of the comptroller of the Chesapeake & Ohio.

So far as the matters disclosed are criminal in their nature they are to be referred to the United States District Attorney at Richmond with the request that prosecution be instituted against all parties therein involved.

TRADE CATALOGUES.

Mine and Quarry.—The current number of this quarterly bulletin of the Sullivan Machinery Co., Chicago, has 30 pages of interesting articles, including the following: "Mining with Hammer Drills"; "Carthage Limestone"; "Adaptability of Hammer Drills"; "Diamond Drilling at Mapimi"; "New York, New Haven & Hartford Railroad Tunnels," and "Mechanical Conveyors as Applied to Long-Wall Mining." They are all written especially for this magazine by men having technical knowledge of the subjects, and are illustrated with interesting half-tone engravings.

Union Pacific.—A pamphlet just issued by the passenger department, entitled "Colorado—A Winter Resort" presents by half-tone engravings from photographs and by interesting text the attractions of Colorado as an all-the-year-round health resort and as a delightful place of residence.

MANUFACTURING AND BUSINESS.

The 2,500 steel underframe stock cars of 60,000 lbs. capacity to be built by the Chicago, Milwaukee & St. Paul will have Bettendorf cast steel trucks and swing-motion bolsters made by the Bettendorf Axle Co., Davenport, Iowa.

The Nathan Manufacturing Co., New York, has appointed Clifford Nathan General Western Manager. Mr. Nathan will make his headquarters at the Chicago office in the Old Colony building and will have charge of the Nathan Manufacturing Co.'s business in the West.

J. W. Scull has resigned as Purchasing Agent of the Pressed Steel Car Co., Pittsburgh, Pa., to become Manager of the Pittsburgh office of the Summit Lumber Co., St. Louis, Mo., makers of yellow pine lumber. Mr. Scull had been with the Pressed Steel Car Co. for the past ten years.

Frank F. Fowle has opened an office as consulting electrical and telephone engineer at 204 Dearborn street, Chicago, giving particular attention to railroad telephone systems, including simultaneous and multiplex telephony and telegraphy, and power transmission and distribution.

R. S. Stangland has been placed in charge of the construction office at New Fort Lyon, Colo., of Muralt & Co., New York, and will superintend the erection of the complete lighting, heating and power plant which this firm is building for the United States Government at the New Fort Lyon naval hospital.

The offices of A. P. Witteman & Co., makers of high-speed and special steels, have been moved to 112-116 North Broad street, Philadelphia, Pa. These will also be the Philadelphia sales offices of the

Chester Forging & Engineering Co., Chester, Pa. A feature of the offices will be desk, stationery, stenographer and telephone facilities for the exclusive use of customers.

George R. Carr, Vice-President of the Dearborn Drug & Chemical Works, Chicago, is on a combination business and pleasure trip to Mexico City. John W. Brashears, who for many years has been first assistant to W. A. Converse, Chemical Director of the Dearborn company, in charge of the analytical laboratories, has been appointed Assistant Superintendent of the manufacturing department.

During January the Duquesne Steel Foundry, which operates a large plant in the Pittsburg district, decided to adopt gas power to operate the works formerly driven by steam. The initial equipment will consist of a 400-h.p. (max.) Westinghouse gas engine of the three-cylinder vertical enclosed type, direct connected to a 240-k.w. generator, supplying current for motor drive. The engine will operate on natural gas.

At the annual meeting of the Union Switch & Signal Co., Swissvale, Pa., the following officers were elected: President, George Westinghouse; Directors, George Westinghouse, Robert Pitcairn, William McConway, George C. Smith, Thos. Rodd, H. G. Prout, and John B. Jackson. After the stockholders' meeting, the directors met and reappointed the same executive officers as had served during the preceding year. The regular quarterly dividend of 3 per cent. was declared.

Harold A. Clark, President of the Central Inspection Bureau, New York, Auditor of the Middletown Car Works, Middletown, Pa., and President of the H. A. Clark Company, New York, domestic sales agents for the Middletown Car Works, died last week at Phoenix, Ariz., where he had recently gone for his health. Previous to Mr. Clark's removal to Middletown, Pa., and his connection with these three companies, he was Assistant Auditor of the American Car & Foundry Company, New York.

The United States Circuit Court of Appeals for the Third Circuit has decided that the Nolan patent, owned by the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., is valid and that the Prudential Insurance Co. has infringed on it. This decision upholds the lower court, from whose decree the insurance company appealed. The Nolan patent is a device for fastening together, and to the supporting castings, the laminae of the cores of electric machines by using a spring split-ring.

The Athens Electric Railway, Athens, Ga., originally generated power at two hydro-electric plants, one about 6½ miles and the other 2½ miles from the city. Extension of the street railway lines and the rapidly increasing power and lighting load made it necessary to build a new power house in the town itself, where for some time past a horizontal steam turbine has been in operation. The requirements have now increased so much that a second steam turbine, of 1,000 k.w. capacity, is to be installed. This, with the generator designed for direct connection to it, is now being built by the Allis-Chalmers Co., Milwaukee, Wis. The unit will deliver three-phase, 60-cycle current at a terminal pressure of 2,300 volts, and is to be excited by a 40 k.w. induction motor generator set, also of Allis-Chalmers manufacture.

OBITUARY NOTICES.

William Horace Holcomb, President of the Holcomb & Hayes Company, died recently at Hinsdale, Ill. He was for two years soon after the war General Manager of the Union Pacific lines and was active in the early establishment of the Railroad Y. M. C. A.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

Canadian Society of Civil Engineers.

At a meeting of the Mechanical Section of this society March 19 a paper on "The Handling of Locomotive Coal and Ashes," by C. F. Whitton, was read by the author.

American Society of Civil Engineers.

At the meeting of this society, March 18, a paper on "The Electrification of the Suburban Zone of the New York Central & Hudson River Railroad in the vicinity of New York City," by William J. Wilgus, was presented for discussion, illustrated with lantern slides. This paper was printed in the "Proceedings" for February.

New York Railroad Club.

At the next meeting of this club, March 20, in place of a technical paper and its discussion, short talks by recognized authorities are to be made on the application of electricity for the operation of trains or important signal systems. Among those who have accepted invitations to speak are: W. J. Wilgus, George Gibbs, Hugh Hazleton, B. G. Lamme and Walter C. Kerr.

Franklin Institute.

At the annual meeting of the institute, March 18, the programme included an address on the Engineering Practice as Applied to the Fueling Equipment of Power-houses, by Harry P. Cochrane. A series of slides of the collapsed Quebec bridge were also shown by Norman R. McLure, who was an inspector during the erection of the bridge. See article on the Quebec Bridge Failure in another column.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Canadian Pacific.—Francis White Peters, who was recently appointed Assistant to the Second Vice-President, who is in charge of the western lines, was born March 25, 1860, at St. John, N. B. After three years education in the schools of that place, he entered railroad service when 13 years old as an operator working with the engineers who were building the Intercolonial. Also in his thirteenth year he was made agent of the road at Jacquet River, N. B. For the next three years he was agent at other points, and in 1876 assistant agent at Newcastle, N. B. In 1878, at the age of 17, he was agent at Chatham Junction, N. B. In 1880 he went to the Chicago & Grand Trunk, now the Grand Trunk Western, as agent, and a year later to the Canadian Pacific as a bill clerk in the local freight office at Winnipeg. Within seven months he was appointed agent at Brandon, Man., where he served for seven years, being then appointed agent at Fort William, Ont. For the next seven years he was local freight agent at Winnipeg, Man. From 1896 to 1899 he was freight agent of the West Kootenay district, with headquarters at Nelson, B. C., and in 1899 was appointed Assistant General Freight Agent with authority over the same territory. In 1900 he was appointed Assistant General Freight Agent of the Pacific division, with headquarters at Vancouver, B. C., and in July, 1901, General Freight Agent of the same division. On January 1, 1903, he became Assistant Freight Traffic Manager of the western lines of the Canadian Pacific, and on March 1 of this year was appointed Assistant to the Second Vice-President, with headquarters at Winnipeg.

Chicago Great Western.—W. J. Ainsworth has been appointed Assistant General Attorney, succeeding John L. Erdall, resigned.

Cincinnati, New Orleans & Texas Pacific.—W. J. Murphy, Vice-President, with headquarters at Cincinnati, Ohio, will take over the duties of T. C. Powell, Vice-President, who has been transferred to St. Louis in charge of the St. Louis-Louisville lines of the Southern Railway. On August 1, 1907, Mr. Powell was elected Vice-President of the Queen & Crescent lines in charge of the operating, traffic and purchasing departments, with Mr. Murphy as the chief executive officer at Cincinnati.

Illinois Central.—J. Ogden Armour has been elected a Director, succeeding Joseph F. Titus, who succeeded Stuyvesant Fish.

Mexican Central.—J. A. Naugle, Assistant to Vice-President C. R. Hudson, has resigned.

Mobile, Jackson & Kansas City.—H. M. Hood, who has been local auditor at Beaumont, Tex., of the St. Louis & San Francisco, has been appointed Auditor of the Mobile, Jackson & Kansas City, with headquarters at Mobile, Ala.

Southern.—The headquarters of T. C. Powell, Vice-President, have been changed from Cincinnati to St. Louis. See Cincinnati, New Orleans & Texas Pacific.

Operating Officers.

Buffalo & Susquehanna.—G. D. Reynard, who has been Trainmaster of the Northern division, has been appointed Assistant Superintendent at Galeton, Pa. His former office has been abolished.

Canadian Northern.—J. R. Cameron, now General Superintendent of the Canadian Northern, entered railroad service in 1882 on the Canadian Pacific at Winnipeg as brakeman. In the next year he was made conductor. In 1887 he went to the Northern Pacific in Montana as conductor, and in 1898 was appointed Trainmaster at Grand Forks, N. Dak., with jurisdiction over the Northern Pacific lines in Manitoba, then known as the Northern Pacific & Manitoba Railway. When in 1901 the Canadian Northern took over these Manitoba lines, Mr. Cameron went with them as a passenger conductor. Three years later, in August, 1904, he was appointed Superintendent of the Canadian Northern at Kamsack, Sask. In December, 1905, he was appointed Superintendent of the First district of the Canadian Northern, with headquarters at Port Arthur,

Ont., and on January 20, 1908, General Superintendent, with headquarters at Winnipeg.

Canadian Pacific.—George J. Bury, who was recently appointed General Manager of western lines, was born March 6, 1866, at Montreal, and was educated at the Montreal College. At the age of 17 he entered railroad service as a clerk in the purchasing department of the Canadian Pacific. He has been with this company ever since. After four years in the purchasing department, he was in 1887 transferred to the General Manager's office. In 1889 he became secretary to T. G. Shaughnessy, then Assistant to the President, now President of the Canadian Pacific. In 1889 he was made Acting Superintendent of the dining, sleeping and parlor car services which, on the Canadian Pacific, are directly controlled by the railroad company. In March, 1890, he was appointed Superintendent of the Western Ontario division. In 1899 he was appointed Superintendent at Fort William, Ont. In 1901 he was transferred as Superintendent to Cranbrook, B. C. For three months in 1902 he was Assistant General Superintendent of the Lake Superior division and then was appointed General Superintendent of the same division. In February, 1904, he was made General Superintendent of the Central division, with headquarters at Winnipeg, and on March 1, 1907, Assistant General Manager of western lines. One year later, on March 1, 1908, he was appointed General Manager of the western lines in charge of maintenance of way and operation.

G. J. Bury.

Delaware, Lackawanna & Western.—George Arthur Poore, the new Superintendent of the Syracuse and Utica division, was born August 21, 1867, at Liverpool, England. He was educated at private schools in England. After having come to America he began railroad work in 1889 on the Illinois Central in the office of a Superintendent, and later was in the offices of the Superintendent of Transportation, the Assistant General Superintendent and the General Superintendent, becoming assistant chief clerk to the General Superintendent. In July, 1900, he left the Illinois Central to become chief clerk to the General Superintendent of the Lackawanna. After four years in this position he was made Superintendent of the Bangor & Portland division from which he was, on March 15, promoted to be Superintendent of the Syracuse and Utica division.

Denver & Rio Grande.—A. F. Brewer, Superintendent of Transportation at Denver, Colo., has resigned to go to another company, and the office has been abolished, the duties being assumed by the Assistant General Manager.

Great Northern.—F. S. Elliott, Assistant Division Superintendent at Willmar, Minn., has been appointed Superintendent at Crookstown, Minn., succeeding T. F. Lowry, transferred to the Montana division.

Illinois Central.—The authority of P. Laden, Superintendent of the Peoria division, has been extended over the Indianapolis Southern Railroad division. The authority of A. H. Egan, Superintendent of the Louisville division, has been extended over the Nashville division, and L. E. McCabe, heretofore Superintendent of the Nashville division, has been appointed Assistant Superintendent of both divisions. The office of Trainmaster of the Nashville division has been abolished. B. F. Galvani, Trainmaster at McComb, Miss., has been appointed Superintendent of the New Orleans division of the Yazoo & Mississippi Valley, with office at Vicksburg, Miss., succeeding F. A. C. Ferguson, resigned.

Missouri Pacific.—W. E. Merrifield, Superintendent of the Northern Kansas division, has been appointed Trainmaster of the Atchison, the Omaha and the Northern Kansas divisions, with office at Atchison, Kan., succeeding J. J. Skinner, now chief despatcher.

E. C. Wills, Trainmaster in charge of the line from Coffeyville, Kan., to Osawatomie, has been appointed Trainmaster of the entire Southern Kansas division, with office at Coffeyville, succeeding C. S. Welsh, in charge of the Chatopa-Larned division, transferred.

Southern Pacific.—T. F. Rowlands, Assistant Superintendent at Sparks, Nev., has resigned.

Yazoo & Mississippi Valley.—See Illinois Central.

Traffic Officers.

Canadian Pacific.—W. C. Bowles, General Freight Agent of the Kootenay district, with office at Nelson, B. C., has been appointed General Freight Agent at Winnipeg of the Central and the Western divisions, succeeding W. B. Lanigan, now Assistant Freight Traffic Manager at Winnipeg.

Chester, Perryville & Ste. Genevieve.—Ralph H. Schultz, Auditor and Assistant General Freight and Passenger Agent at Cape Girardeau, Mo., has been appointed General Freight and Passenger Agent.

Chicago & Alton.—G. W. Quackenbush, Assistant General Freight Agent at Peoria, Ill., will in future have charge of local territory in Illinois and Missouri, with headquarters at Springfield, Ill. E. C. Coffey has been appointed Assistant General Freight Agent, with headquarters at Peoria, in charge of Peoria and Pekin, Ill., and traffic through these places.

Chicago, Rock Island & Pacific.—DeWitt Hammond has been appointed General Agent of the Freight and Passenger departments, with office at the city of Mexico, succeeding C. B. Cleveland, resigned.

Illinois Central.—Thomas James Hudson, General Traffic Manager, has resigned, and the office of General Traffic Manager has been abolished.

Missouri Pacific.—L. D. Knowles, General Agent at Milwaukee, Wis., has resigned.

Northern Central.—Gamble Latrobe, Assistant Engineer of the Baltimore division, has been appointed Acting General Agent at Baltimore, Md., in place of H. W. Kapp, Superintendent and General Agent, who is on leave of absence.

Engineering and Rolling Stock Officers.

Chicago, Rock Island & Pacific.—J. W. Monroe, Shop Foreman at Cedar Rapids, Iowa, has been appointed Master Mechanic at Chickasha, Okla.

Delaware & Eastern.—Otto Franklin Wagenhorst, Chief Engineer, has recently had his authority extended over the operating department with title of Superintendent. Mr. Wagenhorst was born April 25, 1871, at Gouldsboro, Pa. In 1896 he graduated from the University of Pennsylvania. His first railroad service was in 1898, as engineer locating a line for the proposed New York, Wyoming & Western Railroad, which was to have been built by the (then) independent anthracite coal operators from the western anthracite fields to New York City. After this project was given up because of the purchase of the independent anthracite holdings, he worked as transitman in the coal mining department of the New York, Ontario & Western. In 1901 he was appointed Resident Engineer of the Ellenville & Kingston division of this road, where he served for two years; in 1903 going to the Delaware & Hudson as Resident Engineer of the Chateaugay division. On April 10, 1905, he was made Chief Engineer of the Delaware & Eastern, which is now in operation from East Branch, N. Y., northeast to Arkville, 37.5 miles, with an eight-mile branch from Uniongrove north to Andes, and is projected north to Schenectady, and south to the anthracite coal fields.

Kansas City Southern.—George S. Hunter has been appointed Master Mechanic at Pittsburgh, Kan.

LOCOMOTIVE BUILDING.

The Keweenaw Central has ordered one 65-ton mogul locomotive from Ralston & LeBaron.

CAR BUILDING.

The Keweenaw Central has ordered 30 ore cars of 60,000 lbs. capacity from Ralston & LeBaron.

The Maine Central has ordered fifty 50-ton steel side dump gondola cars from the Pressed Steel Car Co.

The Western Glucose Co. has ordered ten tank cars of 100,000 lbs. capacity from the McGuire-Cummings Manufacturing Co.

The Sandoval Zinc Co., Chicago, has ordered four tank cars of 100,000 lbs. capacity from the McGuire-Cummings Manufacturing Co.

The Mt. Hood Ry. & Power Co., Los Angeles, Cal., has ordered 40 flat cars of 60,000 lbs. capacity from the Hicks Locomotive & Car Works.

The New Orleans Railway Light & Power Co. has ordered 35

closed, single-truck electric cars from the McGuire-Cummings Manufacturing Co.

The Cold Blast Transportation Co., Chicago, as reported in the *Railroad Gazette* of March 6, has ordered 200 refrigerator cars from Haskell & Barker.

The Ardmore Traction Co., Ardmore, Okla., has ordered four double truck electric cars and two 30-ft. 10-bench open cars from the McGuire-Cummings Manufacturing Co.

The Chicago, Milwaukee & St. Paul, as reported in the *Railroad Gazette* of March 6, has ordered 12 passenger cars from Barney & Smith and three passenger cars from the Pullman Co.

The Atlantic Coast Line, as reported in the *Railroad Gazette* of March 6, has ordered for the Washington & Vandemere 100 ventilated box cars of 60,000 lbs. capacity from the South Baltimore Steel Car & Foundry Co.

RAILROAD STRUCTURES.

NEW CARLISLE, QUE.—Plans are reported made by the Atlantic, Quebec & Western to replace about 26 of its present bridges with concrete and steel structures, at a cost of about $1,000,000.

NEW CASTLE, PA.—Plans, it is said, are being made for building a bridge over the tracks of the Pennsylvania at the foot of Croton avenue.

PHOENIXVILLE, PA.—The Phoenix Iron Company is putting up a steel bridge 578 ft. long, with approaches at each end of about 100 ft., over the tracks here. It is expected that the work will be finished about May 1st.

PROVIDENCE, R. I.—Plans for improving the dock facilities of the New York, New Haven & Hartford at Providence, it is said, have been completed. From Fox Point to India Point and 700 ft. out from the present wharf line a retaining wall with cuts for three slips, each wide enough for two of the big boats of the Consolidated's fleet, is to be constructed. The space at the rear of the retaining wall is to be filled in, and this will give 30 acres of wharf property over which tracks will be built to connect with the new route to Boston, via East Providence and East Junction. These improvements will cost about $2,000,000.

VERA CRUZ.—The Mexican government is understood to have approved plans for improvements here to cost about $8,000,000. The proposed union passenger station and office building is to cost about $1,000,000, and the rest will be spent for wharfs and warehouses, enlarging track facilities and putting in modern loading and unloading devices. The work is to be carried out by the Vera Cruz Terminal Company, composed of representatives of the various railroads entering Vera Cruz. Local directors of the company were recently elected as follows: J. D. Casasms, to represent the Mexican government; M. G. Ribon, the Interoceanic; Col. Palbo de Escandon and W. Morcon, the Mexican (Vera Cruz) Railway; J. B. Body, the Vera Cruz & Pacific and the Alvarado Railroads; M. Morcon, General Manager of the Mexican (Vera Cruz) was elected Director of the Board, and L. O. Brown, Secretary. The improvements are to be finished in about two years.

YORK, PA.—The Northern Central and Western Maryland Railroads, it is said, have agreed to pay $35,000, and the York Street Railway $25,000 toward building subways at West Market street. The total cost of the improvements will be $75,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

BALTIMORE & OHIO.—Work is now under way for this company as follows:

New yard, engine terminal, etc., at East Side, Philadelphia, nearing completion.

Double-track bridge over the Susquehanna river at Havre-de-Grace.

New freight pier at Locust Point, Baltimore (about 400 ft. of the water end of this pier collapsed when its construction was nearly completed); about 85 per cent. of the wrecking of this part of the pier has been finished. It will be rebuilt. Very little damage was done to the land part of the pier.

Building a 500,000-bushels capacity grain elevator at Mount Clare, Baltimore; work in progress on one-half; provision being made for adding the other half when desired to replace the one destroyed by fire last August.

New engine terminal and enlargement of yard at Parkersburg, W. Va., nearly finished.

Passenger station jointly with the Western Maryland and Coal & Coke at Belington, W. Va.; passenger station and office building at Wheeling, W. Va., to be finished in several months; Medical Examiner's office and Hospital at Holloway, Ohio.

Laying second track between East End, Connellsville, Pa., and Mount Braddock; third and fourth tracks between McKeesport and Glenwood.

Extension of the Gardner Avenue yard, New Castle, Pa.

Construction of freight yard; also in and outbound freight house and office building at Columbus, Ohio, nearly finished.

CANANEA, YAQUI RIVER & PACIFIC.—See Southern Pacific.

CHICAGO, MILWAUKEE & GARY.—This company, organized at Springfield, Ill., with a capital of $10,000,000, is a consolidation of the Illinois, Iowa & Minnesota and subsidiary companies. Plans made for an extension from Rockford, Ill., north via Beloit, Wis., and Janesville to Milwaukee, and on the southern end from Momence, Ill., northeast to Gary, Ind. The Board of Directors include H. W. Seaman, B. H. Harris, Frank M. Clark, William F. McSwiney and Jonas Wafflie, all of Chicago, Ill.

COLORADO, OKLAHOMA & SOUTHEASTERN.—This company, which has projected a line from Weatherfield, Okla., northwest via Independence, Taloga Cestos and Mutual to Woodward, 90 miles, including a bridge over the Canadian river, has negotiations under way to finance the project. P. A. McCarthy, Chief Engineer, Lufkin, Tex.

DULUTH, RAINY LAKE & WINNIPEG.—This company, which last year finished the extension of the Duluth, Virginia & Rainy Lake to the Canadian boundary, at Ranier, Minn., expects to have the bridge over Rainy lake finished about May 1st, thus completing a connection with the Canadian Northern.

GRAND TRUNK PACIFIC.—The National Transcontinental Railway Commission recently received 19 bids for building 365 miles of line, 138 miles in New Brunswick, 52 miles in Quebec, and 175 miles in Ontario. When these contracts are let, 1,224 miles of the total of 1,807 of the government section of the Grand Trunk Pacific will be under contract, leaving 583 miles yet to be let. The bids submitted were as follows:

Section 1.—From a point 58 miles west of Moncton, N. B., 40 miles; Grand Trunk Pacific Construction Co.

Section 2.—For 67 miles to the Tobique river; MacDonald & O'Brien and Grand Trunk Pacific Construction Co.

Section 3.—From the Tobique river to a point 2½ miles west of Grand Falls, N. B., 31 miles; Craig & Thompson; MacDonald & O'Brien; J. T. Davis; Kennedy & MacDonald; the Willard Kitchen Co.; Trites, McPhail, Moore & Miller, and the Grand Trunk Pacific Construction Co.

Section 4.—From New Brunswick-Quebec boundary, west 52 miles; O'Brien & Fowler, J. T. Davis and the Grand Trunk Pacific Construction Co.

Section 5.—From Abitibi, west 100 miles; E. F. & G. F. Farquier and the Grand Trunk Pacific Construction Co.

Section 6.—For 75 miles west of Lake Nepigon; J. D. MacArthur, E. F. & G. F. Farquier, Chambers Bros., McQuigge & McCaffery and the Grand Trunk Pacific Construction Co.

It is estimated that during the summer about 30,000 men will be at work on the whole line from Moncton, N. B., west to Prince Rupert on the Pacific coast.

GREAT NORTHERN.—According to reports this company proposes to resume improvement work this sprong, including the reconstruction of the Kalispell, Mont., division, where the old ties and rails are to be replaced with new ties and 90-lb. rails.

ILLINOIS, IOWA & MINNESOTA.—See Chicago, Milwaukee & Gary.

INDIAN CREEK VALLEY.—Plans reported made to extend this line immediately from Rogers Mills, Pa., northeast to Ligonier, 30 miles. Surveys made for 10 miles. C. F. Hood, President, and S. M. Faust, Chief Engineer, Connellsville, Pa. (March 13, p. 391.)

KANSAS CITY & KANSAS SOUTHWESTERN (ELECTRIC).—Incorporated in Missouri to build an electric line to connect Kansas City with Topeka and Independence, Kan. The company proposes to take over the rights, surveys and other property of a number of projected lines between these places. It is expected to begin work this summer. The directors include J. E. Martin, Minneapolis, Minn.; W. L. Moyer, New York; N. L. Laming, Tonganoxie, Kan.; E. M. Lamken, Kansas City, Mo.; S. M. Brewster, Chanute, Kan.; H. E. Hopper, Indianola, Kan., and C. L. Dudley, Minneapolis, Minn.

LAKE SHORE & MICHIGAN SOUTHERN.—Plans for the elimination of grade crossings on this road have been submitted to the Erie, Pa., City Council for approval. The improvements are to cost $1,500,000.

MEXICAN ROADS.—Surveys are being made by the Creston de Cobre Company for a line from Cerro de Cobre, Sonora, to Port Libertad on the gulf of California, about 40 miles. It is stated that contracts will soon be let.

Compania Industrial del Oro, it is said, will soon begin work on a line from La Huerta, Michoacan, to Tlalpujahua.

The federal government recently amended the concession previously granted to John Henderson to build a line from the port

of Lobos, on the Pacific coast, to Sasme, Sonora. The new agreements require that 15 miles shall be finished by April 1, 1909, and that the entire line shall be finished by December, 1917.

The Gigante Tunnel Railway Company is arranging to begin the construction of a railroad from LaLuz, Guanajuato to Leon and Guadalajara.

A British syndicate is said to have recently bought extensive coal fields in Mier Tamaulipas from the Compania Carbonifera y Irrigadora of Nuevo Laredo, and right of way has been secured over the old grade, originally intended for an extension of the International & Great Northern down the valley of the Rio Grande from Laredo, along the Mexican side of the river to Mier, about 100 miles. Plans have been made by the new owners to build a line to connect its coal fields with the National of Mexico at Nuevo Laredo.

Mexican (Vera Cruz) Railway.—This company, according to reports from Mexico City, has started betterment work on its line between Mexico City and Vera Cruz. About 3,000 tons of rails are being distributed along the line, and new steel ties will be laid where new tracks are put down. A large amount of bridge work is also to be carried out on the line.

Moline, Rock Island & Eastern Traction.—This company, incorporated to build an electric line from Rock Island, Ill., to Carbon Cliff, also from Rock Island south to Galesburg, last year laid 1.55 miles of track from East Moline, Ill., to Silvis. J. T. Porter, of Rock Island, is interested.

Southern Pacific.—The Cananea, Yaqui River & Pacific has concessions from the Mexican government for two branch lines, one from Naco, Sonora, on the Arizona boundry, west along the international boundary to Nogales, Ariz., on the Sonora Railway just north of the boundary, 100 miles. According to the terms of the concession this must be built within 14 months. The other concession is far a branch from Naco, east to Juarez, Sonora, 150 miles.

Tacoma Eastern.—An officer writes that this company has finished a new branch from Anderson, Wash., to McKenna, 16 miles.

RAILROAD CORPORATION NEWS.

Albany & Hudson (Electric).—The holders of the $1,750,000 first mortgage 5 per cent. bonds of this company have been asked to surrender their coupons for 1908 and 1909 and receive in return negotiable certificates which shall be convertible into first mortgage on the basis of $1,000 in bonds for $875 in coupons.

Atlantic Coast Line.—The Attorney General of the state of Connecticut has given an opinion that bonds of the Atlantic Coast Line Railroad no longer fulfill the requirements of the savings bank laws in that state, because the last dividend on the common stock of the company was paid, not in cash, but in certificates of indebtedness. A similar decision was given some time ago in New York state in regard to the Missouri Pacific.

Baltimore & Ohio.—Gross earnings for February decreased 21 per cent., operating expenses 8 per cent., and net earnings 61 per cent.

Carolina, Clinchfield & Ohio.—This is the new name of the South & Western. The new company has authority to increase its capital stock from $7,000,000 to $27,000,000, of which $15,000,000 is to be 6 per cent. preferred stock and $12,000,000 common stock. The road is owned by the Cumberland Corporation and is being built through the coal fields owned by the Clinchfield Coal Corporation, which also is owned by the Cumberland Corporation. It is projected to run from Elkhorn, Ky., on the Chesapeake & Ohio, south via Bostic, N. C., to Spartanburg, S. C., 285 miles. Of this, 101 miles is now built from Johnson City, Tenn., south beyond Altapass, N. C. Work is under way on about 100 miles more. A mortgage is to be made on the railroad, securing $15,000,000 bonds, part of which will be reserved for refunding bonds of constituent companies. The Cumberland Corporation has recently issued $3,000,000 one-year 6 per cent. notes due in February, 1909, by bonds of three of these constituent companies, and also has $15,000,000 six-year 5 per cent. collateral notes of 1912 outstanding. The cost of the road to date is said to be $18,000,000.

Chicago, St. Paul, Minneapolis & Omaha.—Moffat & White, of New York, have offered at 127, yielding about 4.15 per cent., $1,000,000 consolidated mortgage 6 per cent. bonds of 1930. The consolidated mortgage covers the entire railroad of this company and all other property, and is a first mortgage on 627 miles of line. These bonds are outstanding at the rate of $11,871 per mile. Junior to them is $11,300,000 preferred and $18,607,000 Common stock, each paying 7 per cent.

Cincinnati, Bluffton & Chicago.—John C. Curtis, General Manager, was on March 14 appointed receiver of this company, which operates 52 miles of line from Huntington, Ind., via Bluffton to Portland.

Dayton & Xenia.—C. N. Ferneding, of Dayton, Ohio, was on March 13, appointed receiver of the Dayton & Xenia Transit Co., which operates 51 miles of trolley road from Dayton, Ohio, to Xenia and to Spring Valley. Twenty miles of the line is on private right of way.

Great Northern.—The trustees of the Great Northern Ore Properties have made a report for the first fiscal year of the trust, ended December 7, 1907. The total receipts during the year were $1,650,000, administration expenses were $67,750, and the dividend paid September 7, 1907, to holders of certificates of the trust amounted to $1,500,000, leaving a profit and loss credit balance of $82,250. In addition to the 39,296 acres of ore lands leased to the Great Western Mining Co., a subsidiary of the United States Steel Corporation, there are owned and leased 31,238 acres more of ore lands.

Holders of the $4,700,000 first mortgage 5 per cent. bonds, of the Eastern Railway of Minnesota, maturing April 1, 1908, may receive cash for their bonds or may exchange them for Northern division 4 per cent. bonds of the Eastern of Minnesota, due 1948, in which case a payment of $20 per $1,000 bonds will be made.

Illinois Central.—The special stockholders' meeting which has been called for May 18 is to vote on authorizing $28,600,000 new stock, half of which is to be offered to stockholders at par (to the extent of 15 per cent. of their holdings) and the other $14,300,000 reserved against an issue of convertible bonds which may be made.

International & Great Northern.—Gross earnings for the week ended March 14, 1908, decreased 21 per cent., as compared with the corresponding week in 1907.

Lake Shore Electric.—Charles D. Barney & Co. and the Guaranty Trust Co., of New York, have offered at 87, yielding slightly over 6 per cent., a block of the general mortgage 5 per cent. bonds of 1933 of this company, of which $2,160,000 are outstanding.

Lehigh & Hudson River.—See Lehigh Coal & Navigation Co.

Lehigh Coal & Navigation.—It is probable that this company will offer $1,737,850 new stock at par to its stockholders which will be to the extent of 10 per cent. of their holdings. The proceeds are to be used for improvements on the Lehigh & Hudson River and for other purposes.

Minneapolis, St. Paul & Sault Ste. Marie.—A semi-annual dividend of 3 per cent. has been declared on the common stock, raising the annual rate from 4 to 6 per cent.

National Lines of Mexico.—See St. Louis, Brownsville & Mexico.

New York Central & Hudson River.—A quarterly dividend of 1¼ per cent. was on March 18 declared. This is a reduction in the annual rate from 6 per cent. which it has been since the last quarter of 1906 to 5 per cent., which it had previously been since 1899.

New York City Railway.—Messrs. Joline & Robinson, as receivers of the Metropolitan Street Railway, have applied to the United States Circuit Court for permission to issue $3,500,000 receivers' certificates for improvements. They have also filed a complaint against the Metropolitan Securities Co. to recover $4,964,000 claimed to be still due the Metropolitan Street Railway from that company.

Northern Pacific.—Freight earnings for February increased 18 per cent. and passenger earnings 5 per cent. Mail and express earnings decreased 25 per cent. Gross earnings increased 12 per cent. Comparison is with a month of terribly severe winter weather in 1907.

St. Louis, Brownsville & Mexico.—This company is reported to have bought from the National of Mexico, the Texas Mexican Railway, which runs from the international boundary at Laredo, Tex., east to Corpus Christi, 162 miles.

Seaboard Air Line.—The voting trust formed in 1903 to last until 1910 is to be dissolved, on request of the receivers, on March 25.

South & Western.—See Carolina, Clinchfield & Ohio.

Southern Railway.—Directors of the Southern Railway have taken no action in regard to declaring a dividend on the preferred stock.

Texas & Pacific.—Gross earnings for the week ended March 14, 1908, were 23 per cent. less than in the same week of 1907.

Westchester Traction.—Edward G. Benedict was on March 14, by Judge Ward of the United States Circuit Court, appointed receiver of the Westchester Traction Company, which operates three miles of trolley line in Ossining, N. Y.